



Open 
Portfolio
Project

RESEARCH BRIEF SERIES

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RESEARCH BRIEF 1

Open Portfolio Project: Research Brief 1

A NETWORKED VISION FOR SHARING AND DOCUMENTING

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What Is an Open Portfolio?

Portfolios have often been described as a collection of artifacts that can be assessed for a variety of educational and professional purposes. Three types of portfolios, namely (1) *traditional portfolios*, (2) *e-portfolios*, and (3) *processfolios*, lead to our current conceptualization of (4) *open portfolios*, which are designed to better support learning in a digitally networked age and are especially important to makers and makerspaces.

Traditional portfolios present 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 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, traditional portfolios can be difficult to share and thus face limitations in today's digital age.

By contrast, an electronic portfolio, or **e-portfolio**, is a collection of electronic evidence assembled and managed by an individual, usually on the web. Such work may include inputted text, electronic files, images, multimedia, blog entries, and hyperlinks. E-portfolios are both demonstrations of the maker's abilities and platforms for self-expression, and, if they are online, they 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 restrictive access to potential employers or admissions committees.

While traditional portfolios and e-portfolios emphasize the showcasing of finished work, **processfolios** are designed to capture both the finished product as well as the process of creation over time. Processfolios present several unique opportunities to heighten learning by making the thinking around the process of creating visible, an important aspect of learning that often goes undocumented when an emphasis is placed solely on finished artifacts.

The shortcomings of these existing approaches to documenting and sharing work lie in their general lack of openness. Over time, many learners will have pieces or whole portfolios of their work that are isolated and inaccessible across learning settings, failing to link learning in school, home, and community. In these cases, learners can become disenfranchised from their work, with artifacts stranded in systems owned by schools or in platforms that do not allow for easy or automatic exporting/migration over time. However, we know that learners achieve best when their learning is reinforced in, and connected across, multiple settings (Ito et al., 2013).

As a result, we conceptualize an **open portfolio** as an openly networked, decentralized, and distributed portfolio system in which the maker maintains control of the content and curation process. The ideal open portfolio platform would be able to share and exchange information (i.e., 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. Open online platforms can make learning resources abundant, accessible, and visible across settings. Open portfolios seek to revisit the utility of portfolios as a central tool for lifelong learning and as a viable alternative to contemporary assessment practices, while leveraging new technologies to help address the shortcomings in prior educational initiatives.

A Brief History of Portfolios

Historically, portfolios have been used by artists and designers as a *tool for professional and academic assessment* (e.g., admission to schools, securing employment, etc.). Portfolio use as an assessment tool has a long and varied history. In the 1980s–90s, portfolios were heralded by education reform movements as an opportunity to shift the learning landscape in ways that gave legitimacy to children's and

teacher’s voices and also to reflect both the process and product of learning (García & Pearson, 1994). The literature suggests multiple consistent benefits of portfolios, including a direct impact on learner achievement (Dorn, 2003; Gipps, 1999) and as an effective formative assessment tool (Paulson, Paulson & Meyer, 1991; Ewell, 1991). Portfolios have also been shown to be effectively scaled up to larger group assessments (Beattie, 1992; Beattie, 1994) and can be useful for assessing learning in an effort to affect policy-making decisions (Dorn, 2003; Hamilton, 2003).

A number of programs leveraged the historical precedent of portfolio use in the arts toward a variety of educational aims and are worth noting—such as the International Baccalaureate program, processfolios as highlighted in the Arts PROPEL project (Gardner, 1989), and the College Board’s Advanced Placement art portfolio—and can be found more recently in the work of MIT Media Lab’s Build in Progress web-based processfolio (Tseng & Resnick, 2014). While portfolios may be able to scale up, some research literature seems to suggest that portfolio practices function best at the local level within the immediate and contextualized learning environment as potentially dynamic, formative assessment tools (Davis-Soylu, Peppler & Hickey, 2011). Prior attempts at integrating portfolio practice in the classroom sought to transform the educational landscape but, despite their promise, have faced significant hurdles. Some of these hurdles have been economic (considering of the costs of scaling portfolio assessments) and others have been political, including constraints that recent educational policies like No Child Left Behind (NCLB) and the new Common Core State Standards (NCSS) have had on mandated standardized assessment practices, which place severe restrictions on the capacities of school teachers, administrators, and institutions to find the means for incorporating and maintaining portfolio practices.

Alternatively, others have used portfolios as *a tool for learning and reflection*, creating opportunities for examining the whole of one’s work as well as the learning process over time. The value of portfolios as a tool or process for learning and self-reflection has been recognized across a variety of fields. Notably in schools, English Language Arts has incorporated portfolio use with significant success as ways to document work in progress and create points of reflection that may serve as artifacts of learning (García & Pearson, 1994). Similarly, medical education has used portfolios as an effective way for medical students to track their learning and develop habits of practice rooted in reflection (Snadden & Thomas, 1998). Portfolios are now even being adopted within engineering education with a current push by the College Board to develop a new AP Engineering program assessment using portfolios. Others argue that the everyday process of curation itself may function as a reflective process and promote learning. Across these initiatives, portfolios are

important for learners to develop their identities through the everyday curation of their artifacts—be it within art, design, writing, engineering, and especially, making.

Today, there is a rising interest in revisiting the value of portfolios because of their richness as an assessment tool (showcasing the whole of the individual as opposed to a flattened test score) and as a viable alternative to the limitations of today’s standardized testing. Many lessons on how learning takes place through portfolio use have been learned, and we may be able to leverage the portfolio investigations that have come before. This may help us to better point to the efficacy of portfolios from a policy perspective where portfolio assessment is instead rooted in a philosophy that supports learning and values deeper connections across and through disciplines (Gipps, 1999). New technologies particularly present exciting opportunities to rethink and reshape this landscape.

The Promise of New Digital Tools and Open Portfolios

In comparison to paper-based portfolios, digital portfolios use less storage space, are quicker to share and to receive feedback on, and the likelihood for people to stumble across them is higher. Specifically, everyday social media and digital tools, such as the [Flickr mobile application](#), afford sharing photographs of projects and arranging, rearranging, and browsing through shared sets of images using tagging functions of applications. This can lead to expanded learning spaces as representations that may be personalized to the viewer.

Creating short audio-visual narratives of projects in progress using applications such as [Adobe Voice](#) to overlay voice recording with text and digital images, can be a starting point for interlacing short narrative into larger personal or community learning stories. Using free and open tools (e.g. blogs) gives makerspaces the possibility to offer all participants the same starting points for developing portfolios that may be woven across projects and participants.

Digital applications, tools, and platforms that support fast scanning through large amounts of documentation—such as [Instructables](#), the [FiftyThree Paper application](#), and [Carbonmade](#)—can be used to support learning and reflection over time. Tools for creating time-lapse video, such as [Lapse It](#) and [Timelapse](#), can be used in combination with DIY documentation stations to take pictures of project progression, capturing making and mistakes in situ. Additionally, technology use in the creation of portfolios may allow for a more visible connection across artifacts. This capacity can enhance the pedagogical values of portfolios as a system of reflection, connection, process, identity building, and activation (Kimball, 2005).

Advances in technology are often seen as the means toward allowing portfolios to be more meaningful in the

21st century. Through this lens, we can push back against the idea that e-portfolios are merely electronic versions of print portfolios and consider that we appropriate them differently as we express ourselves through various media (Yancey, 2004). The digital portfolio can allow individuals to craft representations of themselves in deeper ways through the multiple contexts that can be developed using the variety of media and tools available for constructing digital portfolios.

Conclusions and Recommendations

In our work toward developing effective digital portfolio practices for young makers, we are considering how new technologies afford us to:

Rethink our current standardized assessment

practices and reclaim the historic role of portfolios in the assessment process to more holistically represent the abilities of the learner. New digital tools and technologies present new opportunities to rethink current assessment practices and to find more affordable ways of scaling approaches to portfolio assessment.

Conceptualize a more openly networked and

decentralized portfolio development that can support both the learner and the learning process over a lifetime. When thinking about developing a portfolio practice, it is important to think about sustainability of the work beyond the (institutional) learning situation that the work was developed within.

Automate the documentation of process and product of making,

particularly within maker communities. Making with physical tools and materials presents a burden with regard to capturing the process and product; unlike digital tools, there is no embedded button or opportunity for data to be auto-collected. However, we know that documenting process is particularly important to learning. New hardware, software, and practices are needed to support the type of learning taking place using the various tools available in makerspaces.

Our next research brief will highlight the importance of portfolios in maker communities and at a national selection of makerspaces. We will present the tools and practices used in their documentation and portfolio efforts, as well as the current challenges these sites are tackling in the creation of open portfolios.

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References

- Beattie, D. K. (1992). The Feasibility of Standardized Performance Assessment in the Visual Arts: Lessons from the Dutch Model. *Studies in Art Education*, 34(1), 6.
- Beattie, D. K. (1994). The Mini-Portfolio: Locus of a Successful Performance Examination. *Art Education*, 47(2), 14-18.
- Davis-Soylu, H. J., Peppler, K. A. and Hickey, D. T. (2011). Assessment Assemblage: Advancing Portfolio Practice through the Assessment Staging Theory. *Studies in Art Education*, 52(3), 213-224.
- Dorn, C. M. (2003). Models for Assessing Art Performance (MAAP): A K-12 Project. *Studies in Art Education*, 44(4), 350-370.
- Ewell, P. T. (1991). To Capture the Ineffable: New Forms of Assessment in Higher Education. *Review of Research in Education*, 17, 75-125.
- García, G. E. and Pearson, P. D. (1994). Assessment and Diversity. *Review of Research in Education*, 20, 337-391.
- Gardner, H. (1989). Zero-based arts education: An introduction to ARTS PROPEL. *Studies in Art Education*, 71-83.
- Gipps, C. (1999). Chapter 10: Socio-Cultural Aspects of Assessment. *Review of Research in Education*, January 1999; vol. 24, 1: pp. 355-392.
- Hamilton, L. (2003). Assessment as a Policy Tool. *Review of Research in Education*, 27, 25-68.
- Ito, M., Gutiérrez, K., Livingstone, S., Penuel, B., Rhodes, J., Salen, K., Schor, J., Sefton-Green, J., and Watkins, S. C. (2013). *Connected Learning: An Agenda for Research and Design*. Irvine, CA: Digital Media and Learning Research Hub.
- Kimball, M. (2005). Database e-portfolio systems: A critical appraisal. *Computers and Composition*, 22(4), 434-458.
- Paulson, F. L., Paulson, P., and Meyer, C. (1991). "What Makes a Portfolio a Portfolio?" *Educational Leadership*, pp. 60-63.
- Snadden, D. and Thomas, M. (1998). The use of portfolio learning in medical education. *Medical Teacher*, 20(3), 192-199.
- Tseng, T. and Resnick, M. (2014). *Product Versus Process: Representing and Appropriating DIY Projects Online*, pp. 425-428. Published in the proceedings of DIS 2014, June 21-25, 2014, Vancouver, BC, Canada.
- Yancey, K. B. (2004). Postmodernism, Palimpsest, and Portfolios: Theoretical Issues in the Representation of Student Work. *College Composition and Communication*, 55(4), 738.

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RESEARCH BRIEF 2



THE IMPORTANCE OF PORTFOLIOS FOR MAKERS

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How Are Makers Using Portfolios?

The capturing and sharing of work is critical to maker culture. The world has come to know the Maker Movement through the documentation of maker projects—many of which are imaginative and quirky—through photographs, videos, and step-by-step tutorials openly shared through social media sites, online communities, magazines, and in-person events like Maker Faires. The portfolio of work created by makers reflects the individual makers, their local makerspaces, and their surrounding communities, curated as they are through individual and group practices that determine the shape, intended audience, and depth of documentation. And yet, the frequency and extent to which makers are involved in capturing their work, as well as the role that portfolios play within maker culture, is unknown. Given the increasing acceptance of maker portfolios in job and college applications—MIT, for example, accepts portfolio submissions as a demonstration of the applicant’s ability to “learn, create, and problem-solve in an unstructured environment” (MIT Admissions Office, 2013)—the time is right to reconsider how portfolios can most effectively translate the value of one’s making to a broader audience.

A Selection of National Makerspaces and Their Approaches to Portfolios

In our work, we have sought to illustrate how makers are currently approaching portfolio design and creation. In this brief, we present three cases of how portfolios are being utilized in makerspaces, whether these are large lab spaces in museums, mobile carts in classrooms, or a shared corner of a community library. In particular, we are highlighting how the practices reflect open portfolio characteristics, such as how young makers maintain control of the content and the curation process. Those

presented here are compelling cases, among many, within the rapidly growing network of maker education programs and youth-oriented makerspaces. Throughout our research brief series, we will return to these sites and introduce several other innovative makerspaces with emerging portfolio practices (see Appendix A).

The Children’s Creativity Museum: Encouraging Documentation in Museums

The *Children’s Creativity Museum*, centrally located in San Francisco, CA, is a family-oriented art and technology museum in a light-filled building that offers imaginative hands-on maker activities on two floors. Children and adults are invited to actively engage in the digital media learning opportunities related to the museum’s exhibits. Museum visitors can explore stop-motion animation and green-screen karaoke, for instance. Seamlessly integrated into the activity itself are digital documentation workflows, as well as nearby physical documentation stations that enable visitors to easily record and save their work.

The museum’s public showcase of projects, as well as the accompanying emphasis on documentation, helps to develop a greater sense of community-connected learning that extends beyond the walls of the museum. For example, the Animation Studio contains not only stop-motion animation stations but also shelves filled with colorful materials and tools. Each station is composed of a background, a camera, a large screen for viewing animations in progress, and a table for arranging animation sets and props. Children and families construct clay characters and tell stories together, with the option to take the whole experience home. Animations can be sent to the museum’s file-sharing account and from there shared with individual filmmakers. Families may download their movies at home that very evening.

The Music Studio includes a green-screen stage, two microphones, and a full production station run by museum educators. Children dress up in costumes provided by the Children's Creativity Museum, perform or record music videos, or recite nursery rhymes alone or in groups. A camera is positioned in front of the stage, recording the performance and projecting it onto a large screen behind the camera. Young performers watch themselves on TV as they perform, and all video-recorded performances are temporarily stored for performers, should they choose to burn them to DVD to take home. Visitor's creations can be easily used in their own lifelong portfolios; they can interact with their files beyond the museum setting, as individual media files are shared and accessible after a museum visit to strengthen their learning across learning spaces (Ito, et al., 2013). No additional login information or membership to a particular service is required.

Evidence of work is visible throughout the museum. Artifacts from past experiences are interwoven into the open character of the space. This type of display demonstrates the museum's ongoing focus on not only the activities but the documentation of them as well. The showcase of finished work and works-in-progress invite visitors to create their own unique projects, and in turn, visitors create products that they can take home, evidence of their engagement while in the museum.

The Imagination Lab on the museum's first floor includes crafting tables with daily hands-on activities for children, with past projects displayed above or behind each table. Visitors are encouraged to document their creative process through prompts from museum educators and instructional signs. The museum itself continues to evolve, demonstrating the improvements and attention toward the importance of capturing work. An older 2D animation station reflects that evolution, as a sign there reads: "Sorry, there is no saving at this station. Make, save, and send on Snap It 2.0," referring visitors to the newer animation stations with increased capabilities.

Another strategy to motivate visitors to make and capture their work is a constantly changing exhibition throughout the museum called "Imagine Your Art Here." On the wall in the Animation Studio, a group of picture frames displays photographs of children's past clay figures, as well as printed statements of "Imagine Your Art Here." These framed glossy prints show animation sets in-progress and animation production processes in-action. Additionally, educators at the Children's Creativity Museum are currently redesigning "Imagine Your Art Here" into an interactive and multimedia representation of work.

Children's Creativity Museum staff are also actively developing ways to capture visitor work in other parts of the museum. For example, they are thinking of ways to better document the process behind the mystery box challenge, in which children are presented with a certain level and challenge, then pick a box of random materials

with which to rapidly prototype an invention. In addition to taking photographs, there may be an opportunity for children to use an iPad mobile app to explain how their invention works, pitch their ideas through storytelling, and share their inventor's thought process articulations. Continuing to encourage documentation at the museum and beyond, educators at the Children's Creativity Museum are also designing ways to feature and share stories of visitors' making on their official website.

The Learning Portfolio Project: Using Processfolios

The [Learning Portfolio Project](#) is a collaborative effort between the DreamYard Project, Parsons The New School for Design, and DreamYard Preparatory High School in New York City, aiming to increase access to expansive portfolio development for 9th-grade through 12th-grade students. The multi-year portfolio initiative bridges in-school, after-school, and college-level learning through shared portfolio practices. While the first year of collaboration focused on the integration of portfolio practices in the afterschool program at the DreamYard Project's Art Center and the DreamYard Preparatory High School program, the efforts of the second year are to extend the experiences to more educators at each of those locations and to faculty of portfolio-documentation courses of the pre-college program at Parsons The New School for Design. The collaborators meet once a month to share experiences and develop a shared vision across the intersecting spaces.

Similar to the principles of Project Zero's Arts PROPEL (Gardner, 1989), the initiative encourages youth to capture, share, and communicate the process of learning. Currently, in concert with public in-person showcases, young makers use blogs to show their process and document their work. Their projects, which are often infused with social justice themes, include such areas as the exploration of urban cultural appropriation and ethnic identity through the creation of fashion and interactive fashion photography activities.

The project trains and supports educators and youth in the use of blogging tools to capture the process of learning and creating, including project iterations and reflections on decision-making. In the process, it illuminates effective practices around portfolio development achieved through the balance of tool use and facilitated practices. For example, young makers are instructed to record and post at least three photographs of their material choices and products in progress. They may use their own smartphone devices or the computers offered by educators. They are also required to write short reflections about their progress, sometimes requiring prompting from educators and suggestions of sentence starters. Each young maker has his or her own blog that is linked to a main teaching blog, curated by the program educator. Educators model the work by showing their own blog entries to youth, helping to

inspire youth work and also naturally allow for reflection on past activities.

When presenting work to funders or the general public, the initiative often shares one adult-driven blog and some youth blogs. While no separate blogs are created for these occasions, the overall collection of blogs acts as a repository of evidence to draw from. The Learning Portfolio Project goes beyond traditional portfolio approaches in art and design to include other subject areas, such as global studies, math, anatomy, fashion, and digital media. As the project continues to develop, the educators involved are hoping that youth will maintain their own learning blog to showcase in-school and afterschool learning, as well as personal interests, helping to paint a holistic portrait of the youth beyond test scores and lists of activities.

Findings from the Learning Portfolio Project reflect all aspects of portfolio design and development, whether related to educator practices or the affordances of traditional and new tools. For example, the initial act of hand-writing blog posts plays a surprisingly helpful role, as transferring handwritten content into digital posts encourages additional iteration and reflection, allowing young makers to take a deep look at their own personal development. To aid in training and support, educators create shared resources that include tutorials, worksheets, and templates for creating various posts, example class blogs, and rubrics for assessing the quality of posts. The DreamYard and Parsons team also find that the generation and collection of content, prior to actual portfolio development, is an important first step. Creating repository-like blogs for documenting all learning (whether project-related or not) over time automatically leads to further reflection and curation.

The Learning Portfolio Project blogs are hosted on a public site, and young makers retain their accounts after completing the program and can continue to curate and post new work to the blog in the years that follow. The programs openly share their approach through monthly professional development opportunities for area teachers. The greatest challenges of the project so far include: supporting the range of comfort and familiarity with digital literacy skills (including typing and navigating the web and blogging platforms); ensuring access to shared technology in the school setting; and helping educators find the time to both plan and teach new lessons that incorporate blogging.

The Chevron Maker Annex of the Children's Museum of Houston: Division of Labor and Specialization

The [Chevron Maker Annex](#) is a recent addition to the Children's Museum of Houston. A makerspace for museum patrons and youth to create hands-on projects with help from staff, it is located on the lower level of the

three-story museum and within the Invention Convention gallery. In contrast to many of the other museum galleries also open to youth and adults, including large groups of campers, the Chevron Maker Annex seems like a calm island, open during scheduled demonstrations and sign-up workshops. The space includes state-of-the-art tools and materials, such as a 3D printer; laser cutter; numerous crafting, woodworking, and electronic hand tools; and general space to accommodate large electronics, soldering, and work areas. During the summer, staff in the Chevron Maker Annex primarily consist of Maker Corps Members, who are young adults (college age or older) taking part in Maker Ed's Maker Corps program to deliver summer programming and work as makers-in-residence at host organizations around the country.

Four engaged Maker Corps Members drive many emergent portfolio practices through a Children's Museum of Houston website, [kidmakers.org](#), to document and reflect on project milestones. An in-progress documentation space, the site includes profile descriptions of the adults working in the space, descriptions and reflections of workshops facilitated at the Chevron Maker Annex (e.g., creating a light-up robot using e-textiles or building a wooden box), projects created by the Maker Corps Members for children to duplicate (e.g., a video game controller made with play-dough and a Makey Makey board or an Arduino-controlled robotic arm), and explanations of tools available at the space (e.g., 3D printer and hot glue gun).

Through the [kidmakers.org](#) website, which continues to evolve as practices are refined, Maker Corps Members, whether intentionally or not, present themselves as both participants in and resources for the maker and maker education community. Their work naturally folds into maker culture while also drawing out key pieces that help to delineate themselves from others. For example, Maker Corps Members create and post detailed step-by-step guides of their projects to [Instructables](#) that are then linked to [kidmakers.org](#). They strategically tag posts and projects on both websites with popular keywords and are motivated by community feedback, the number of views they receive, the duration of website visits, and the understanding that they might help others undergoing similar processes.

As a third branch, these posts and projects are often linked to the Maker Corps G+ Community page as well, sharing their work with yet another dedicated audience of makers in education. These pieces lead to self-assessment, iteration, improvement of work, and most importantly, continued sharing of work-in-progress, promoting openness as an integral aspect of maker culture. As they present their work and themselves, an ongoing question that the Maker Corps Members at the Chevron Maker Annex often ask is: How can we showcase, communicate, and share our work to inspire and invite others to engage in similar projects?

Currently, Maker Corps members are documenting their own work and are beginning to build a portfolio culture at the site. Their practices are visible to the youth participating in Chevron Maker Annex workshops, for example, who might reference the website during a workshop and look at past projects to see what a final product could look like. Besides a mobile documentation station, no formal process for documenting workshops and making exists; the emergent process actually helps springboard the documentation process for young makers. These staff are engaging in and exploring the kinds of practices that they are hoping for the youth to practice at a later time.

In shaping emerging portfolio practices, questions have surfaced at the Children's Museum of Houston and, in particular, in the Chevron Maker Annex and Invention Convention exhibit. The lead educator responsible for Invention Convention and the Maker Annex wonders about the authenticity of documentation. In managing the Maker Corps Members and watching as the website and practices evolve, he senses a tension between the motivation to document process and the motivation to finish a project, as a product that is "camera-ready is different than [the] finished product." Displaying a visually appealing but unfinished product may compel makers to stop short of the whole process, potentially missing out on important making and learning experiences along the way. In light of this question, the museum educators are further developing ideas around documentation.

What Are Some of the Emerging Ideas Found Across the Cases?

Several commonalities, whether successes or challenges, emerged across this early selection of makerspaces and their approaches to portfolios. These cases speak to the ongoing progress that educators, facilitators, and youth are making in the development of effective practices for maker portfolios. Across these cases, several ideas related to the effective design of portfolio practices surfaced, including (a) strategically placing visual and audio prompts that remind young makers to document; (b) supporting inclusion and merging of digital and non-digital practices; (c) establishing open portfolio practices by offering ways for young makers to use and access their work independent of one institutional space; (d) taking advantage of and harnessing the possibilities of using common digital media tools, including blogs and tagging features; and (e) encouraging adults to model documentation practices for and with young makers by participating in the same activities and portfolio work as youth. At the same time, it is important to stress that maker portfolio practices need to be adapted to suit the needs of a particular setting and, as such, there is not a set of universal practices, tools, or workflows that can be espoused in all settings.

With these evolving design ideas, we also acknowledge the challenges that arise when creating opportunities for open portfolios. Some of these include questions of how to document, related to comprehensive and automated documentation, selective and manual documentation, individual and collaborative practices, and mobile and stationary documentation spaces.

Additional findings from our field observations and design research experiments will appear in forthcoming research briefs. The next research brief will highlight hardware and software tools for documentation, including do-it-yourself (DIY) documentation stations and how they may help young makers explore and start thinking about their own open portfolio needs and wishes.

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References

- Gardner, H. (1989). Zero-based arts education: An introduction to Arts PROPEL. *Studies in Art Education*, 71-83.
- Ito, M., Gutiérrez, K., Livingstone, S., Penuel, B., Rhodes, J., Salen, K., Schor, J., Sefton-Green, J., and Watkins, S. C. (2013). *Connected Learning: An Agenda for Research and Design*. Irvine, CA: Digital Media and Learning Research Hub.
- MIT admissions office (2013). MIT admits 612 accomplished and diverse students through early action — New maker portfolios enhance optional application supplements, retrieved from <http://newsoffice.mit.edu/2013/mit-admits-612-accomplished-and-diverse-students-through-early-action>.



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RESEARCH BRIEF 3

DIY DOCUMENTATION TOOLS FOR MAKERS

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What Tools Are Makers Using?

Key to documenting a maker's work and creating portfolios is the need for tools to document making over time. While there are a few options that are commercially available, makers are creating their own tools and systems to integrate the physical and digital worlds. We are finding that these types of DIY documentation tools are critical for makers to capture, share, and reflect on their work.

Unique Challenges of Maker Documentation

Making is often a highly mobile activity. While in some spaces makers occupy temporary workstations dedicated to projects-in-progress (see Research Brief 5: "Maker Portfolios in Informal Education"), most makerspaces allocate areas for specific activities, such as stations for soldering, 3D printing, and woodworking, among others. In these cases, the creation of a project is frequently distributed across a diverse range of workstations that are loosely tied together by the maker's practice. The mobility needed in making challenges the idea of a fixed documentation space and recording documentation of the entire process.

In addition to being mobile, making typically occurs over a long period of time and requires sustained concentration. In the flow of making, makers often want to keep doing what they set out to do, rather than pause for documentation. This places tension between balancing automated documentation (which generates large amounts of data) with manual forms of documentation (which can interrupt the maker's flow), and is connected to hardware and software challenges.

Software and hardware designed to capture making needs to build on the mobility of making, give room for sustained concentration, and strike a balance between collecting too much data versus not enough.

As makers float between workstations, transportable and lightweight ways to capture still and moving images of the making process are needed. Integrating documentation into the making process, as well as making it conveniently accessible, can support the concentrated flow of making. While obvious design ideas may involve automated documentation and capturing the entire process of making, an ideal documentation tool limits the editing of documentation as well. It captures the essential steps of the make—nothing less, nothing more. Tools that provide makers with control over capturing, while being mindful of disconnects, are the basis for creating open portfolios for making.

Capturing with Phones and Tablets

Today's tablets and smartphones are equipped with high-quality cameras and easy-to-use applications for capturing and editing photos and videos. Thus, it comes as no surprise that these are the most commonly turned-to tools for documenting work in makerspaces. Whether they are provided by the makerspace or are the makers' personal devices, these tablets and smartphones act like buddies on the side, positioned on the table next to the maker or tucked into back pockets.

The problem with using such ubiquitous devices for documentation is that their presence is frequently taken for granted. Conceiving of the smartphone and tablets as they would for any other activity, makers might take photographs and videos of their work early on, and, as the making continues, forget about the presence of the tool. Out of the maker's sight and mind, someone else might step up and borrow the device, not knowing that it is in use. Furthermore, when makers do remember to pick up their phones or tablets to snap pictures, these pictures are oftentimes taken quickly and are blurred, making it difficult to recognize technical or decorative details.

Furthermore, using the cameras on most phones and tablets requires a custom mounting device to stay in position (in addition to other inconveniences such as the device frequently going to sleep). While such mounting devices are on the market, they can be costly and difficult to remember to bring along to the make. However, the broader maker and DIY (do-it-yourself) community offers creative and adaptable ways of stably mounting personal tablet computers and smartphones devices, reappropriating everyday materials for simple assembly. We share some of those solutions here in this brief. These smartphone and tablet mounts furnish the capturing of making, and we refer to them as “DIY documentation stations.”

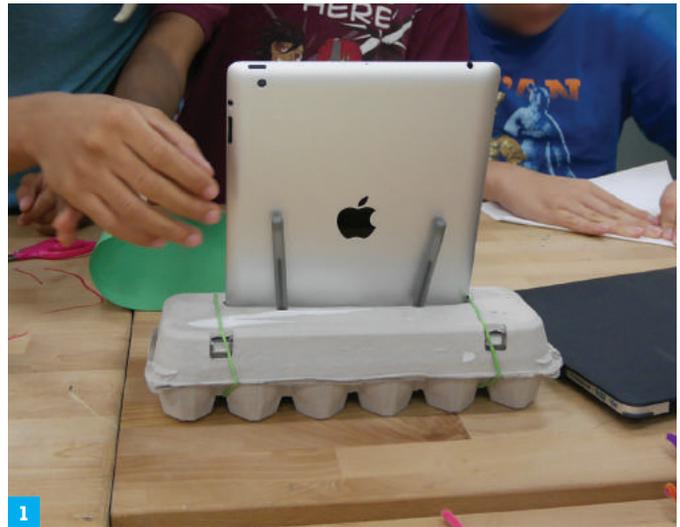
DIY Solutions for Maker Documentation

In this research brief, we have sought out a range of potential tools for creating maker portfolios and offer a survey of inspirational instructions of DIY documentation stations using everyday materials. These tools extend the capacities of smartphones and tablets for capturing making, putting makers in the mindset to document their work by closely integrating these tools into the environment and workflow. For example, a screen can be stably positioned using everyday materials without assembling an elaborate documentation station. Using the screen as a mirror, an always-on camera can record much of the process or only key parts of making at the click of a button. Some of our favorite DIY documentation solutions are highlighted here.

Quick to assemble, lightweight, and easily transportable, **the egg carton tablet stand (1)** (Piikeastreet, 2012) transforms a typical egg carton into a stable, upright cradle for a tablet. A rectangular slit that is the width of the horizontal or vertical edge of a tablet is cut into the lid of the carton. Small weights inside the carton stabilize the station, and two pencils poked through the egg carton lid prevent the tablet from tipping over when placed into the rectangular perforation.

The egg carton tablet stand affords unobstructed access to the front and back cameras of most tablets. Young makers can take pictures of themselves with their work (“product selfies”) using the front camera of the tablet, communicating to the world, “It’s my project and someone else did not make this.” Without repositioning the stand, makers can then use the rear camera to easily snap a picture or video of their project in isolation. The stationary design helps to avoid motion blur of handheld tablet photography, though young makers will often take advantage of its mobility by sliding the tablet stand across a workstation to snap picture series of other makers working at the table.

The documentation station can also support keeping documentation in mind by integrating a tablet into the environment and flow of making. Situating the stand

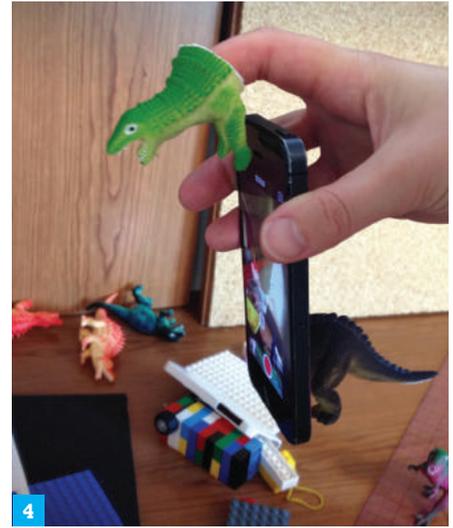


While we found numerous examples of 3D-printed tripod mounts paired with downloadable models, we took particular notice of those DIY documentation stations for tablets and smartphones that do not require access to high-tech equipment, since such high-tech tools may not be found at all sites and/or would take some time or specialized skills to produce.

behind the project and using the front-facing camera as a mirror, makers can gain a secondary perspective on their project as they work. This helps young makers not only refine their process, but also keeps the documentation vantagepoint salient in their mind as they work (thus helping to minimize the likelihood that they would forget about the tablet partway through their project). With the record stop/start button within close reach, makers can integrate documentation fluidly into their workflow and avoid the overly large data files that come from letting the camera run continuously.

A design drawback of the egg carton documentation station is its inflexibility: once assembled, the stand only fits one particular device and has a fixed angle. This limits makers’ capacity to capture making happening above or below the fixed angle of the camera position. Furthermore, young makers occasionally employ another person to take their portrait pictures or videos, as makers with project-filled hands cannot click the capture button or may wish to avoid covering the screen for the initial few seconds of a video. This means that the flow of making for others may be interrupted.

Designed to capture a bird’s-eye view of projects-in-progress, **the poster board smartphone stand (2, following page)** (Re, 2013) balances a smartphone on an elevated arm above a unicolored base. The shape of the arm, cut out of poster board, is folded to create a platform at the center of the arm for the smartphone to be placed onto. Wedges cut out of the cardboard facilitate the folding of the thick material. Two perforations matching the width of the arm are made into the base of the documentation station for mounting the folded arm. For additional stability, the arm can be taped to the base and a smartphone case can be attached to the platform atop the arm.



The poster board smartphone stand is lightweight, mobile, and quick to assemble. Makers can customize the camera angle by raising and stabilizing the phone using cardboard and tape. Once the stand is assembled, most makers treat the camera height as fixed.

Given the consistent camera angle and capacity for creating unicolored backgrounds, the stand is ideal for capturing stop-motion animations and documenting the step-by-step evolution of a product (as animated GIFs or stepwise procedures). By setting their projects on the base of the documentation station, makers simply remove their hands from the camera's view to click a picture before resuming their work. This documentation station gives makers easy access to capturing with minimal interruption to the flow of making.

Using the base of the station as a workspace also offers makers control over what to capture: the recording can be always on or can only capture parts of the process. However, the height of the poster-board arm presents affordances and challenges for the maker. For low-height arms, makers can view their project through their phone screen, though this obscures a direct view of their hands. Conversely, a high arm lifts the camera above a natural viewing angle for the maker, recording a large view but making the process of checking the shot and capturing footage more laborious.

The smartphone Lego back cover (3) (Recyclelovers, 2014) is a simple, yet versatile documentation station. A flat Lego piece is taped to a smartphone, smartphone cover, or a tablet. By attaching another Lego piece to a flat surface, the smartphone with the Lego back cover can easily be fastened to any place, including a flat wall, the ceiling, the edge of a table, or even a bicycle. This DIY documentation station is easily and quickly constructed and offers a range of creative means for capturing making. A buddy that can be picked up and become part of the action, the smartphone Lego back cover can be an interesting tool for capturing making in planned and creative ways, such as capturing video

footage from a bicycle, the ceiling (for wide-angle videos of a group of makers at work), or even the neck of a guitar (Digital Harbor Foundation, 2014).

The highly mobile potential of this design is also its drawback. Similar to using a smartphone without any form of docking station, pictures without stabilization can turn out blurry, and it can be difficult to remember to pick up the smartphone from the table. This means that documentation with this station may need to be planned before making, rather than spontaneously snapping photos in the moment. Furthermore, the DIY documentation station does not necessarily succeed as a tool for integrating documentation with the flow of making nor does it address the challenge of collecting too much or too little data.

For a more playful perspective, **the dinosaur smartphone stand (4)** (Venantio, 2013) is a fun way of repurposing plastic action, animal, or dinosaur figures in service of documentation. Any plastic toy cast of two pieces can be separated. By adding glue to one half of the toy and sticking a suction cup to the piece, the toy can attach to the back of a smartphone to create a personified, attention-grabbing documentation tool.

The dinosaur smartphone stand is mobile and can be transported to any workstation. Due to its playful appearance, many young makers gravitate instantly to these figures, augmenting documentation with storytelling. They pick up the action figures and begin to narrate their own stories and voices. Uniquely, this DIY documentation station shifts the focus from the documentation of one's own making to the documentation of the making of others. While this potentially interrupts the flow of making for others, it also presents an opportunity for a reporter-type maker who inquires about the work of others. The documentation of another person's work also means that control of what is being documented is shared between two people: the interviewer, who decides what to inquire about, and the interviewee, who decides what

to reveal. In the conversation, which is suggested by the dinosaur smartphone stand, a form of collaborative making may emerge.

Discussion and Future Steps

These four are but a small selection of the numerous DIY documentation stations that offer mobility and stability for capturing project making in progress. Examples of other documentation stations focus on portable photography kits for taking professional-looking photographs, as well as 3D-printed tripod mounts for stabilizing smartphone and tablet cameras.

Documentation allows makers to stage themselves in relation to their projects, choosing to be in the picture and a part of the story or letting the product speak for itself. In selecting which tool or combination of tools to use, makers may also need to choose when to document, taking into consideration how much they desire to curate their work and identity. Continuous documentation of the making process may mean that makers are not interrupted in their flow of making. However, as makers move from one location to another throughout their process, they must remember to move their documentation tools and stations with them. If makers collect a large amount of data, they must also consider the time needed to sift through that information; choose representative photographs, videos, or words; and reframe their experiences. Without simple ways of editing, the number of photographs and length of video recordings might make it challenging for makers to compile and share compelling media. Long videos are difficult for the larger community to parse through and draw meaning from. In contrast, selective documentation of their processes forces makers to be more conscientious with their planning and consistent with their documentation practices. They may have less data to draw from, but the curation process will likely be shorter and simpler. With either approach, makers are refining their own best practices for telling their stories and offering insights to the wider community.

At the intersection of planning portfolio creation, processes of documentation, and intentional curation of collected content are the tools of documentation. Through our research and site visits, it has become apparent that many tools used to create portfolios are not specifically intended to document making or the processes of learning through making. With the recurring need to balance manual and automated ways of capturing, software and hardware tools need to solve open questions and be customizable for different activities and different audiences. They can help identify simpler production workflows that support the capture of digital and physical artifacts, collaboration across platforms and between multiple users or groups, and the sharing of resources across diverse online channels.

DIY documentation stations were important starting points to explore new ways to address some of these

challenges. In addition, current software developments in the field were brought to the forefront in our conversations and site visits. Two notable ones are:

Tackk, an online tool and mobile application for easy authoring, editing, and designing of web pages. Interesting features include drag-and-drop arrangement of layout items, simple media embedding capabilities, and automatic saving of progress.

Build-in-Progress, an online tool specifically designed for makers to document and visualize their process through a progressively growing tree structure representation. Designed by Tiffany Tseng of the MIT Media Lab, the tool is focused on documenting individual projects created by one or many makers.

We recommend investigating the design of time-lapse tools for photography and videography to reduce post-production needs, supporting the mirroring effect for reflective process of making, exploring attribution of co-created projects, and advancing ways for layers of identities to be revealed, including how portfolios may serve to develop and share identities related to groups or spaces.

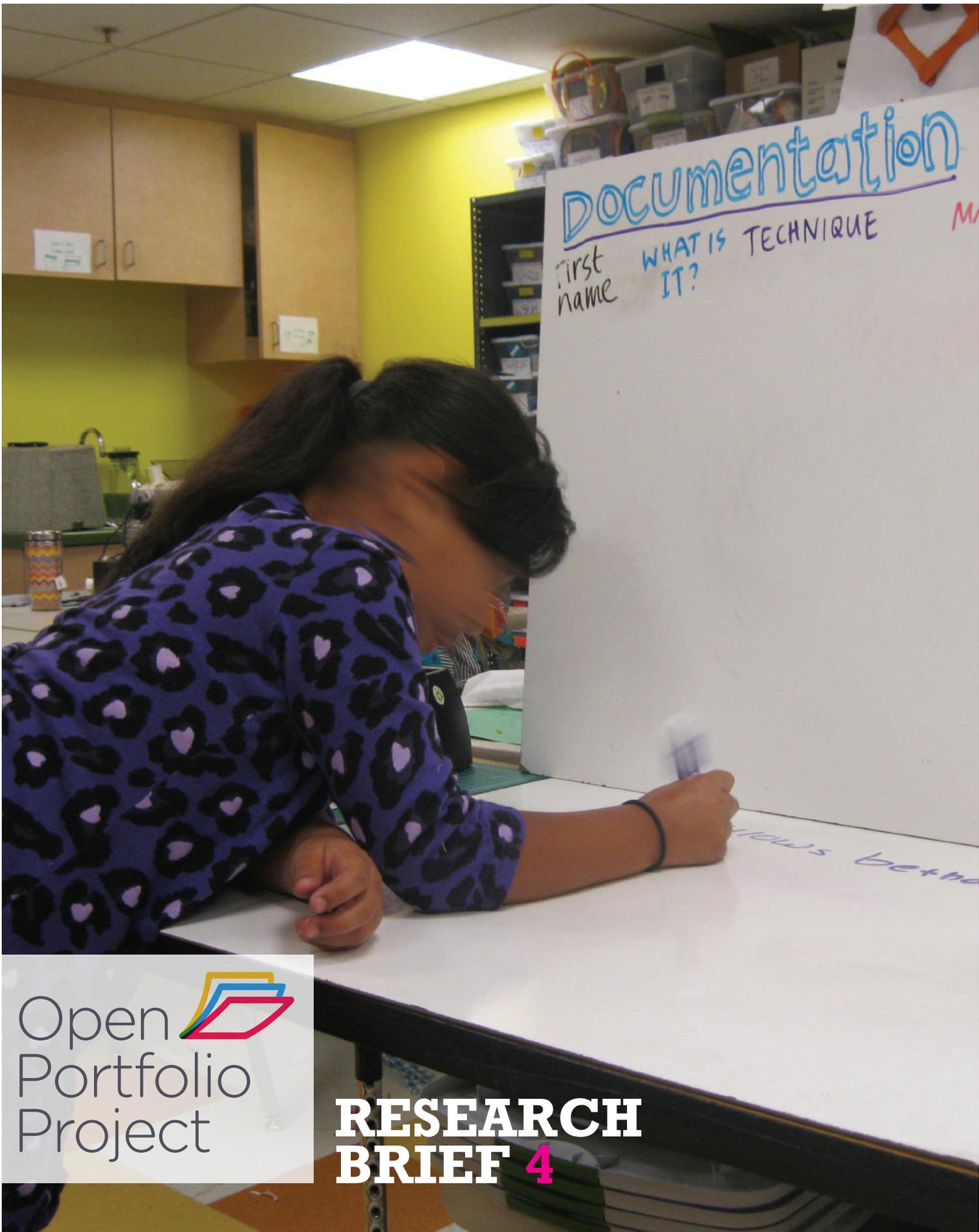
In addition, openly networked design activities may contribute to our understanding of how tools and practices better connect. These could include convenings of researchers and practitioners who share their learning and processes at different stages of their own portfolio design and development, linking together ideas among the maker education network.

Acknowledgements

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References

- Digital Harbor Foundation (2014). Highlights from Our Spring Youth Showcase, retrieved from <http://www.digitalharbor.org/2014/06/23/spring-youth-showcase/>.
- Piikeastreet (2012). DIY iPad Stands, retrieved from <http://www.piikeastreet.com/2012/08/diy-ipad-stands/>.
- Re, G. (2013). iPhone Scanner, retrieved from <http://www.instructables.com/id/iPhone-Scanner/>.
- Recyclelovers (2014). DIY iPhone Lego Back Cover—5 Useful Features, retrieved from <http://www.recyclelovers.com/2014/01/diy-iphone-lego-back-cover-5-useful.html>.
- Venzio, S. (2013). Make: Dino iPhone Tripod, retrieved from <http://www.eatsleepmake.com/2013/07/make-dino-iphone-tripod.html>.



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RESEARCH BRIEF 4

MAKER PORTFOLIOS IN SCHOOLS

Stephanie Chang & Lisa Regalla, Maker Ed
Anna Keune & Kylie Pepler, Indiana University

How Are Makerspaces in Schools Using Portfolios?

As seen in the field sites previously highlighted in “The Importance of Portfolios for Makers,” youth-oriented programs and makerspaces are approaching portfolio design and development in unique ways. For some, portfolios are seamlessly integrated into the design and display of artifacts, activity stations, and the physical space. For others, documentation starts as an internal process and then carefully spreads and engages with a wider audience. No matter where our field sites are in their own processes of portfolio creation, it is becoming clear that portfolios, whatever form they take, are a convincing means through which making—and learning—is captured.

In our research and field site visits, we see emerging patterns across all settings as well as distinct differences, often specific to the audiences and communities served. In the cases presented in this brief, we examine four very different schools in K-12, all situated to bring portfolios and making to the forefront of their work. They are Monticello High School in Charlottesville, VA; Lighthouse Community Charter School in Oakland, CA; Marymount School of New York in NYC; and the Ravenswood City School District in East Palo Alto, CA. In what can be seen as strict academic settings, these sites are working through their own maker processes by iterating on their models of portfolio use and in turn playing a significant role in showing how portfolios and portfolio experiences exist as a key tool for assessment and learning.

Monticello High School: School-Wide Portfolios

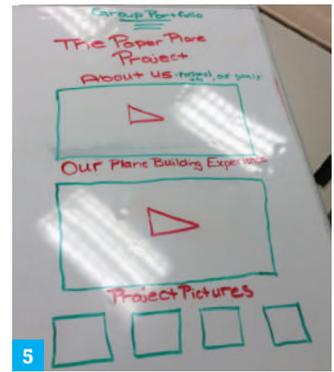
Nestled in the rolling hills of Charlottesville, VA, Monticello High School is a large, public, comprehensive high school within the Albemarle County Public School (ACPS) system, which serves Charlottesville’s urban,

suburban, and rural communities. Within Albemarle, making has gained significant momentum in the past few years, spearheaded by the efforts of superintendent Dr. Pam Moran, and ACPS continues to pave the way in showing how an entire school district can capture the spirit of making in integrated ways.

In the 2013–2014 academic year, Monticello High School took a bold step, instituting school-wide portfolios for its 9th and 10th graders. With every new year, incoming freshmen start portfolios, and soon, students at all grade levels will have digital portfolios alongside their transcripts, GPAs, and standardized test scores. Notably, Monticello is a unique place, and it became a field site for our Open Portfolio Project research because, among others, its experiences provide strong insights into how portfolios are functioning for administrators, teachers, and students alike within a standard school environment.

During the two-day site visit to Monticello in September 2014, it was fascinating to be back in the hubbub of a vibrant high school community, but what stood out as particularly special is the school’s library and media





about the best ways in which portfolios will enable deeper learning. Individual classes at Monticello, such as Photography and Culinary Arts, have portfolios or portfolio-like practices already, and other reflection and curation practices are in place in certain subjects.

One element of our field site visits is a series of design workshops in which both students and teachers make

center (2). It serves as a central hub for students and teachers alike, reaching the max capacity (per fire code) each and every day. The library is a soaring, open, sunlit space with high ceilings and a back wall full of windows (3). There are smaller wings on both sides and a perimeter of separate rooms (4). Lots of chairs, small couches, stools, desks, and low tables are scattered throughout the space. The library also houses a music recording studio, a makerspace, a hackerspace, and many other multi-use, interdisciplinary spaces where students hang out and work and where teachers often bring classes. The library, with a front help desk filled with gadgets, half-finished projects, and a 3D printer being troubleshot, is a prime space for making, but making happens throughout the school on a daily basis, whether in Monticello's official shop space, in the library, or in classrooms that range from art to computer science to cooking and math.

Monticello's portfolios are designed and developed on Google Sites, a default platform that faculty are starting to realize may be more challenging than originally anticipated. Creating pages, adding artifacts, and building menus are proving technically difficult for both students and teachers, requiring more training and support. A Google template site is provided to all students, who are allowed to customize it as they see fit. Administrators readily admit that not all staff are on board, though many teachers are excitedly thinking

paper airplanes while also capturing their processes (1, **previous page**). The results and conversations afterward highlight some of the patterns we're seeing arise from portfolio work; in many places, it's clear that the product and focus shift away from being on the paper airplane and toward the video, photos, or text that document the process (5). Similarly, though process is not necessarily a focus from the start, once participants start thinking about it, they begin to discuss how it may be more important than the final result.

Anecdotes from teachers and students show the successes and challenges that surround the implementation and use of portfolios. Some students wanted to think harder about what goes into their portfolios, expressing interest in planning out which work—indicative of their experiences, interests, or growth—might be best for the portfolio. Students also commented that they could see benefitting from the sharing of portfolios with peers, whether to learn from each other's processes or to use other portfolios as a standard of comparison. Some teachers also mentioned that it might be best for students to capture and archive *all* of their work. If students are making so much stuff and creating so much content for their portfolios that they can then curate what to show, that's an ideal problem to have! One particular point of Monticello's emphasis is to ensure that students have continued access to their work, whether personal or school-related.

Lighthouse Community Charter School: Blogging and Making Across Platforms

An innovative K-12 public charter school located close to the airport in Oakland, CA, [Lighthouse Community Charter School](#) serves a largely Hispanic and low-income student population. At school, seniors stroll alongside pint-size kindergarteners, and in the past few years, one particular theme has been emerging in all K-12 curriculum, classes, and approaches: making.

Many years ago, making began at Lighthouse as part of a high school Robotics elective, taught by science teacher Aaron Vanderwerff; while his students built and programmed robots for the BotBall tournament, they also created independent projects to share at the Maker Faire. As the class evolved, Aaron began to develop a year-long plan: simple, skill-building projects (that still allowed for personalization) in the first few months, and during the second semester, self-directed projects born entirely of student interest, to be shown at [Maker Faire Bay Area](#) every May.

Since Fall 2013, making has developed into a school-wide effort, integrated into classrooms and subjects across K-12 and centered at the interdisciplinary makerspace, named the [Creativity Lab](#). It's a colorful room of standard classroom size with walls lined with floor-to-ceiling shelves, all filled with well-organized see-through plastic bins of materials, including modeling clay, pom-poms, nets, tinker toys, fabric, markers, paint, googly eyes, resistors, DC motors, hole punches, tape, crayons, sticky notes, and puzzle pieces. Two sinks, some floor equipment (a large-format printer and vinyl cutter), a small "office" area with desks and chairs, and additional shelving that contains visual, tangible examples of student projects and works in progress, more supplies, and a growing library of educational and making books fill out the perimeter of the room. In the middle are six student tables with about four to six chairs each where students gather to make, create, and design.

The Creativity Lab program, as of September 2014, hosts four part-time educators, teaching Making electives (7th-12th grades) and in the ASP **(6)** (after-school program), and two [Maker Ed AmeriCorps VISTA volunteers](#), who focus their efforts on behind-the-scenes coordination and implementation of making experiences within and outside of Lighthouse.



Maker Ed's AmeriCorps VISTA program, in partnership with the Corporation for National and Community Service, places VISTA volunteers, who commit to a year of service, in high-poverty communities around the nation to help build the capacity of a select organization. With Maker Ed, VISTA volunteers are working with organizations on professional development, outreach, communications, and development efforts, among others, all to create more opportunities for youth to make. At Lighthouse, they work with teachers to develop projects and integrate making into the curriculum of core classes (e.g., science, math, humanities, home, language, etc.), as well as create professional development opportunities for teachers in Oakland Unified and beyond. In K-4th grade classrooms, the Creativity Lab staff also work with teachers to create mini-makerspaces within their respective rooms. And the high school science and robotics classroom serves as yet another makerspace, hosting more of the woodworking and heavy-duty equipment **(7 and 8)**.

Vanderwerff and other teachers have been actively thinking and experimenting with documentation over the past three to four years, whether through developing project guides for others to use or promoting student documentation in preparation for Maker Faire. Students who head to Maker Faire Bay Area have created posters



of their projects in order to highlight their work and processes, and art teachers have set aside time in class, allowing their K-6 students to curate a portfolio of their individual pieces. In the summer of 2014, the team experimented with a simple documentation station that took center stage in the Creativity Lab, in order to capture what summer students were creating. The high school Making electives kept a [Tumblr blog](#), where posts were often prompted by simple direction: Take a picture of your project in its current state, and write about what you did in the past week.” The tagline of the blog? “Lots of people making lots of stuff.”

As Lighthouse continues to integrate making into its students’ everyday learning, it’s obvious that making takes many different forms and styles. As such, documentation and portfolios do, too. One particular student—who might be found hiding from math class to make stuff instead—is in the midst of creating a laser harp, a project she started last academic year. When describing her ongoing harp project, she says that instead of using regular strings, “I use lasers.” They’re implanted through the bottom of the harp, and photodetectors are added at the top; when a player crosses his or her hands through the lasers, the lasers are disrupted and the harp plays a sound. She does not write much in the class blog, but she actively uses her notebook, sketching in it and organizing it in a way that helps her easily locate the information she needs (like measurements). Why does she not blog? She answers, “It’s not about not liking technology or blogs; I like to have it on-hand.” This example helps us better understand the inclinations and tendencies of students in their documentation practices, maybe even preferences for tangible objects, as well as the challenges facing the creation of digital portfolios. In this instance, we see how portfolios can serve different purposes; some are created for oneself (e.g., organizing, sketching), and some are created for others (e.g., showcasing, sharing).

At Lighthouse, this documentation is leveraged when students advance from one grade grouping to the next (every two grade levels). At these stages, students undergo a review of their work in a “Passage Presentation” with teachers and parents, showcasing a portfolio of “big projects” that are kept in a binder and passed between teachers. In thinking about making, this set of passage milestones may be the perfect opportunity for capturing even more student work.

Marymount Fab Lab: Portfolios of Practices

The Marymount Fab Lab, one of four highly equipped makerspaces at [Marymount School of New York](#), an all-girls K-12 private school, is one of 10 field sites the Open Portfolio Project core team visited as part of our efforts to learn about the portfolio and documentation practices of youth makerspaces. Technology Integrator

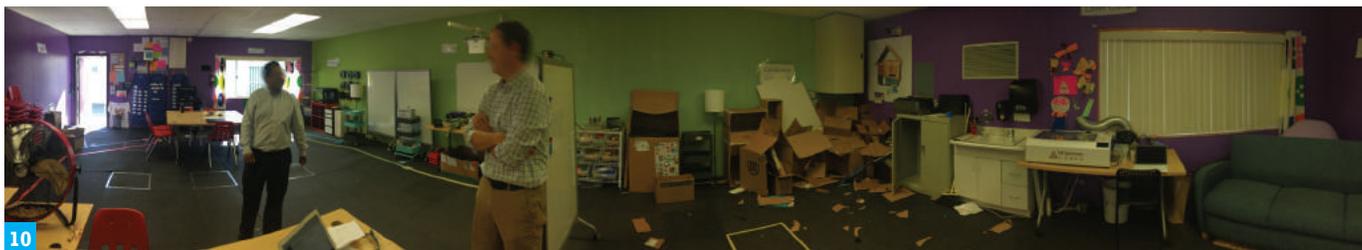
and Fab Lab Administrator Jaymes Dec kindly agreed to an extended virtual visit in November 2014 through a video call with our team, telling us more about the Fab Lab, an open studio space for young female makers to explore, invent, and design projects based on their personal interests. Math and science classes are also occasionally held at the space. During our video call, Dec also gave us a tour of the space and talked to us about ongoing documentation practices.

The Marymount Fab Lab is a workshop space filled with state-of-the-art 3D printers, an embroidery machine, a laser cutter, a milling machine, electronic materials and toolkits, and a walk-in closet full of grab-and-go consumables from fabric scraps and cardboard to take-apart computers and monitors. One of the shelves in the Marymount Fab Lab is dedicated to a treasury of physics and computational gadgets, such as conductive ink, acquired by backing Kickstarter projects, for the young makers to tinker with. Beneath a workbench that spans a wall are many transparent boxes that contain glue sticks, popsicle sticks, pipe cleaners, Arduino boards, and much more. The boxes are labeled with calls for action, such as “decorate something,” “hold things together,” and “invent something.”

The Fab Lab’s vinyl cutter is actually located in the digital visualization lab of the school, a wide, open space mainly used for meetings around works in progress and exhibitions of past projects, expanding maker practices outside the Fab Lab. Much of the visual documentation of the Fab Lab is also situated in the digital visualization lab. Wall-mounted screens show professional-quality photographs of past projects, and shelf space is reserved for young makers to store projects in progress, visible to anyone with access to the school (9).

In the Fab Lab, during open studio classes, Dec takes photographs of the young makers at work using a semi-professional SLR camera. The camera is equipped with a wi-fi-enabled SD card that transfers the pictures to a computer and organizes them into a folder, automating one technical aspect that might hamper documentation practices. Currently, the photographs are mainly used for external communication, but there are future plans to give students access to the folder as well.





Apart from visible documentation outside the Fab Lab, the lab itself also includes posters of small group work, updated as projects progress. The idea is that the posters grow as the work develops, documenting students' challenges, turning points, and decisions as they work on their projects. At the end of the school year, students are asked to present their work (either prototypes or documentation) to a jury of upper-level students and faculty, to articulate their problem statement, encountered challenges, how the challenges were addressed, and where they plan to take this work. Separate from the juried presentation, documentation is frequently used for assessment. Videos and pictures stand as proof that the students of the group really did the work, that it worked and satisfied the challenge, and that student teams collaborated.

Similar to the space, documentation practices are a work in progress for the Marymount educators. During our video call, Dec mentioned that he would love to see every student carefully study their mistakes through documentation in order to become more aware of their practices. Additionally, through documentation, every student could develop a portfolio in preparation for college and professional applications to set themselves apart from other applicants.

As making and makerspaces—including highly equipped spaces such as the Marymount Fab Lab—are increasing in schools, the importance of understanding how to leverage excellent portfolio practices across spaces is increasing. The virtual visit at Marymount presents excellent examples of how schools are starting to move toward making without compromising on student interests. We see that open portfolios play a role in this, for example, through shaping assessment practices and automating aspects of documentation to support smooth connections between making and portfolio creation, setting students up for academic and professional success beyond school.

Ravenswood: Makerspaces District-Wide

The [Ravenswood City School District](#), just north of Silicon Valley, CA, serves a predominantly Hispanic population in East Palo Alto and surrounding neighborhoods. Over the last two years, Robert Pronovost, the Lead STEM (science, technology, engineering, and math) Coordinator, has spearheaded

an enormous effort to design, build, and establish seven makerspaces in schools throughout the entire district. His personal passion, making mixed with coding and robotics, form the basis of the activities in the makerspaces, many of which are in varying stages of completion. One, located in a mobile classroom at the [Los Robles Dual Immersion Magnet Academy](#), is up and running—and thriving (10).

Currently, the hope—in addition to having a space at every school—is to have enough funding to allow the makerspaces to be open to the community, with dedicated facilitators at each site to welcome not only students but parents as well. The open day in 2013 was well-attended by parents, and they experienced first-hand the excitement that emanated from kids and adults. The Ravenswood makerspaces are also looking to integrate with curriculum and existing classes, whether science, social studies, or language arts. There's also potential for an “Introduction to STEM” course for 4th and 5th graders, led by a certified teacher who is also well-versed in and excited to facilitate making experiences.

In addition to the building of physical space, documentation of making is a close second in priority. The coordinators at Los Robles explain that documentation helps youth see what's possible. It provides students with examples of projects by peers, and it showcases the successes as well as the processes—all of which require perseverance, development of skills, and problem solving. Project samples allow others in the greater community to glimpse what's happening in school and provide a spark for students to start making things for themselves. On another level, documentation is a clear assessment of student learning. It provides evidence of whether the makerspace supports student development, and it feeds back into the cycle of self-improvement with information on what works and what does not. It also provides, quite simply, data for topics like material popularity. Documentation allows coordinators to better understand which materials should be kept in stock.

The makerspace at Los Robles contains snippets of documentation in all corners. Students who log into Tinkercad use a group account for the makerspace, allowing students to easily see each other's work. On one shelf with multiple bins of projects is a digital photo frame that rotates through photos of projects



and youth. In another corner of the room is a glass display of 3D-printed objects (11), all by students, near the 3D printer. Buckets with projects in progress sit on shelves all along the wall, and near the back corner is an example of a simple Makedo house, inspiring kids to build their own out of the pile of cardboard nearby. On tables in the middle of the room are also project examples, some being actively developed by staff and some being tinkered on by students. As part of a unit on green energy, a small-scale wind turbine sits on the edge of the table, facing a large box fan, ready to generate power. Up front, a project binder is filled with individual pages of student writing and drawings, some with a simple jotted idea or goal and others with writing and reflections on every stage of work. That binder is the initial, informal step towards portfolio creation.

Students initially came to the makerspace during recess and lunch. With growing demand, the makerspace began to stay open to classes outside of lunch. Students who hesitantly joined in last year are now leading and helping others; they are already familiar with tools and thinking about future projects. Students come to the makerspace to learn Tinkercad, work on projects, collaborate with others, and even focus on homework. With digital cameras that are wi-fi-enabled, facilitators record the action via video and photo, and coordinators are thinking about how they will have students share their work from one makerspace to another, connecting all of the district sites. Pronovost mentions that he'd like to eventually have ID cards for all students, each card containing data on what skills they've mastered and what interests they have. Students will be able to support peers through their own expertise and experiences.

There is a unique opportunity brewing at Ravenswood: the community of makers and makerspaces being built will develop organically to fit the needs of the specific school and youth, and their connections to one another will allow for easy sharing and demonstration. Each

makerspace will both reflect and showcase the passions of its individual audiences. In turn, the portfolios created—whether representing the individual or a group identity—will do the same: they will be an ever-growing collection of physical and digital artifacts that capture the facets of what youth and educators are doing.

Commonalities Across In-School Portfolios

There were several commonalities that emerged across our in-school site visits, including portfolio practices that (a) integrated making and instituted portfolios across grade levels and subject matters; (b) leveraged the rich collection of artifacts as evidence of learning through making, as a seed to continue the spread of making into other spaces and with other teachers; and (c) seamlessly designed documentation and the capture of work as part of the process of making. Some significant challenges still exist too, and sites are addressing them steadily, learning from one another's findings. They continue to try and test digital tools and platforms, such as blogging sites, to determine which are most easily adopted by schools and adapted to teacher and student needs. Engaging with a broad range of teachers to think through how portfolios can be effectively utilized in their classrooms and in conjunction with their teaching norms is also a work in progress. These commonalities are particularly salient within in-school environments and, as seen in the next research brief, are addressed in different ways in out-of-school settings as well.

At all of the field sites described in this brief, one particular insight continued to stand out: the need for portfolio development to simply be an ingrained part of the making process instead of standing apart as an addendum.

Field sites are exemplifying this need (and its solution) in multifaceted ways. When educators set the stage by establishing expectations and creating time to capture photos and video, reflect, and share, youth will do just that. And in the process, their focus on making expands beyond just the product or project itself; it grows to encapsulate their efforts on both the making and the documentation.

Acknowledgements

The work of Maker Ed's Open Portfolio Project is made possible by generous support from the Gordon and Betty Moore Foundation. We also thank the members of the National Working Group, who provided constructive comments and valuable insights to our work.



RESEARCH BRIEF 5

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MAKER PORTFOLIOS IN INFORMAL EDUCATION

Stephanie Chang & Lisa Regalla, Maker Ed
Anna Keune & Kylie Pepler, Indiana University

Portfolios in After-School, Community, and Library Programs

Informal education programs offer incredible opportunities for youth, allowing them to expand their learning, immerse themselves in new and exciting environments, and zero in on interests. It would seem that these types of environments would also be ideal for the development of portfolios, as youth are able to spend a long duration of time working on a single project or refining a set of skills. Through our field site visits, however, it's evident that, no matter what the educational setting, youth-oriented makerspaces and maker programs are working through similar challenges. Convinced that portfolios are a compelling means for assessing learning and abilities, sites are still figuring out which facilitation methods are most effective, what tools to use, and how to best capture work, work in progress, and the process of making. These informal programs do bring together groups of passionate instructors and peers, determined to set the stage for youth to learn and grow.

In combination with several of our prior research briefs, this particular brief concludes the snapshots into the 10

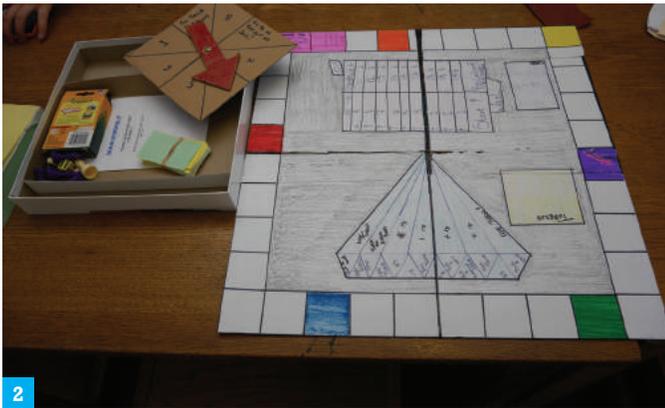
field sites that participated in our Open Portfolio Project research. In this brief, we highlight Millvale Community Library near Pittsburgh, PA, Digital Harbor Foundation, a teen makerspace in Baltimore, MD, and the Bay Area Video Coalition (a San Francisco, CA, nonprofit that offers programs on digital media production)—three youth-oriented programs at non-school sites that reflect the growth and insights of their distinct communities and programming.

Millvale Community Library: Making and Shaping the Library

The Millvale Community Library is one of 10 field sites the Open Portfolio Project core team visited to learn more about the ongoing portfolio and documentation practices of makerspaces. Led by Library Board President and volunteer Brian Wolovich, the community of Millvale helped restore a former shop front into a light-flooded library and a place for youth and adults to continue to imagine, create, and transform their community. Their makerspace, where most of the library's maker programming happens, is located toward the back of the library and is accessible through the front and back doors. During our two-day visit in August 2014, young makers and adult library visitors entered the library, browsed books and the internet, and joined ongoing maker activities.

The makerspace includes large table spaces in the center of the room (1), filled with playdough, hot-glue guns, hammers, and nails on Maker Thursdays, and the space is veiled in fabric pieces and textile works in progress on Fiber Fridays. Other themed days include Bike Tuesday, when all bicycle-related projects are tinkered with, and a gardening and crafting theme on Wednesdays. The shelves and closets along the walls are filled with books, circuitry blocks, games, fabric scraps, bicycle pumps, yarn, jars with consumables, and works in progress. A colorful glass mosaic of flowers leans against





2



3

the fireplace, and the cement on the floor next to the fireplace creates one of many impromptu workspaces for projects in progress. Much of the work in the library is in progress and continues to be shaped in collaborative efforts with the youth makers.

The projects in progress and their provisional workspaces are a predominant part of the documentation at the Millvale Community Library makerspace. A wooden sign with illustrations of tools, including pliers, a hammer, and scissors, is leaning against a bookshelf. Through small projects like this, Maker Corps Members, who are summer staff trained by the Maker Education Initiative and working on-site at Millvale, are hoping to disseminate some of their learning and teaching into the space to lend support even after their summer engagement.

During our visit, we learned about the unique process behind the design and development of the board game “Diamondopoly” (2). Initially a brainstorming exercise over the course of two weekends, library visitors were asked to come up with board game ideas and rules and write them on sticky notes, all added to a larger poster. The ideas and rules were compiled by a team of maker educators and youth, and an oversized game board was created. After a few rounds of playing the game, one of the female makers, who recently turned 18, decided to translate the game into a boxed version and name the game after herself, Diamond. Since then, the game has traveled all the way to a gaming convention in

Indianapolis and continues to be developed further.

Coincidentally, when we visited, the educators and youth were in the process of conceptualizing how to present makerspace activities to parents of the young makers and to the wider Maker Education network at an upcoming local street festival. In homes outside the library, access to the internet and computer technology is limited, thus documentation of activities focused on balancing print-based media and digital practice. During our design workshop, which stretched across the two days of our visit, we curated a large collection of photographs of summer activities through an emergent practice, in which one idea informed the next (3). Children, who had innovative suggestions and initial ideas, were supported and encouraged to continue developing those thoughts through the offering of materials and further conversation. For example, as youth were browsing through the existing online collection of photographs, one nine-year-old narrated the images with imaginative and funny dialogues. We documented his comments and offered more computers so more youth could add captions to the pictures. The children also marked the pictures that were most representative of memorable making activities. We printed the captions and selected pictures at a local print shop and then spread the prints on a large table and sorted the images in relation to the themes of the makerspace schedule. Subthemes, such as mosaic making and rainmaker construction, were conceptualized as tags and hashtags for loosely connected online portfolios that would span across the existing Millvale Library channels, including social media, blog, and photo repositories.

Much of the documentation was also intended to enhance the greater library space, showcasing the activities of the makerspace through posters displayed in other parts of the library. The poster was constructed on oversized cardboard, blending leftover materials—including fabric, wood, and mosaic pieces—with printed photographs and handwritten youth maker captions.

Through this collaborative practice of commenting, sorting, tagging, and simultaneously working across digital and print media, we noted key design ideas that portfolios would need to have in order to work in the Millvale Library: equal access to the photo repository for all collaborators; the ability to sort pictures as a dialogical process of constructing categories in collaboration; audio recording and drawing features for very young makers (who cannot yet read and write) to record and leave comments; a common account through which everyone can contribute; the ability to show processes and practice, for example through animated GIFs; and the use of paper journals and sketchbooks as repository of ideas.

The field site visit to the Millvale Community Library informs our thinking of emergent portfolio and documentation practices and uniquely presents the role

that works in progress and participatory engagement may have on shaping the makerspace. We generally think of libraries as drop-in spaces, and to some extent the Millvale Community Library makerspace is, because it is open for extended amounts of time and visitors come and go, often several times per day. At the same time, the visitors at Millvale also return frequently and can therefore work on projects over a longer period of time. In this sense, this grassroots community space is unique and can broaden our understanding of what it means to support portfolios in drop-in makerspaces.

Digital Harbor Foundation: Designing Expectations to Tackk

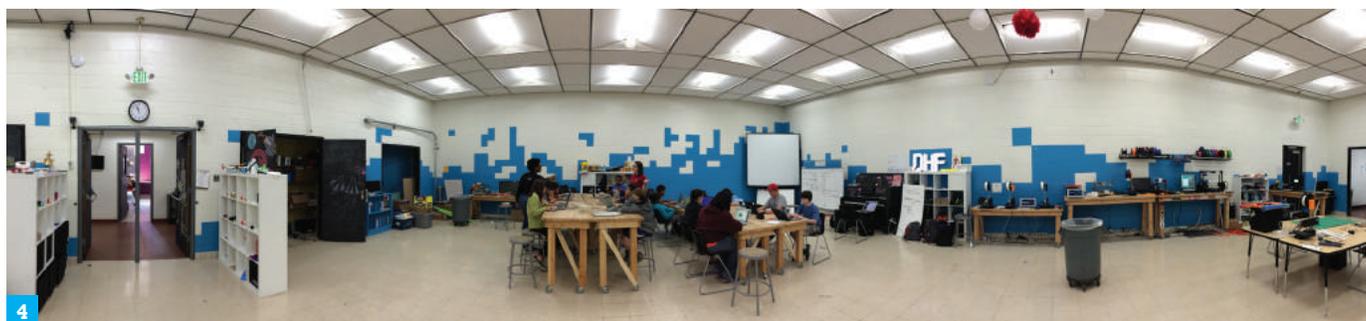
In July 2014, one of the first field sites the Open Portfolio team visited was [Digital Harbor Foundation \(DHF\)](#), a youth tech center located near the Inner Harbor of Baltimore, MD.

In transforming an abandoned Baltimore City Parks and Recreational Center into a space for youth to make and learn, DHF has provided not only a physical location for making but also a close-knit community of youth and families who share skills, stories, and inspiration. Digital Harbor's main lab area is a big open room, filled with a mix of tables, stools, couches, and workspace (**4 and 5**). Its perimeters and walls are lined with tools (e.g., an array of 3D printers), consumable materials, student projects (whether fully finished or still in progress), and whiteboard sketches. When we visited, half of the room was full of summer campers focused on their Tinkercad creations, while in the other half, youth members and staff mingled, diligently working on their own projects.

During our two-day site visit (much of which was centered around observations of the Mega Lab 3D printing summer camp for middle and high schoolers, as well as a series of conversations and participatory design workshops with both staff and youth members), we were struck by the online tool that campers were using to document their 3D printing camp week and projects.

Digital Harbor has been thinking carefully about portfolios and documentation for a while now. They've prototyped numerous platforms already, having tried WordPress and Evernote. At the time of our visit, their year-round youth members and summer campers were using—with much success—an online tool called Tackk. Campers took photos and screenshots, wrote and reflected, and posted paragraphs daily about their individual projects to the group website for that week's 3D printing camp. Camp counselors set expectations for campers to Tackk (a verb now!) at the end of every camp day. The interface is simple but customizable; youth mentioned that it's easy to use and, importantly, the sites look good. Periodically, campers looked at the project sites of fellow campers, and some even tracked the number of views they were receiving. Youth were encouraged to work on their Tackks and projects outside camp as well, setting a precedence for open development. Daily posts also innately showed the progress of and process behind visible project work—an automatic processfolio of sorts.

These observations, conversations, and participatory design workshops revealed a plethora of factors that both youth and staff deem to be critical for any portfolio tool or practice: visual appeal, simplicity of use, open and easy access, automated means of documentation,





regularity of posts and reflection, individual and collective identities, and automatic feedback. Their actions also showed how they best interact and respond to the task (or opportunity) of documenting their work, whether in process or as a finished product. These features are critical pieces of our research into what and how people capture for portfolios.

Bay Area Video Coalition: Portfolios for Self and Others

The [Bay Area Video Coalition](#) (BAVC), located in the Mission neighborhood of San Francisco, has been inspiring and guiding the community through digital media production for almost 40 years now. Their [Next Gen](#) programs, serving predominantly underrepresented youth, provide teens with both the hard and soft skills to pursue their interests and potential careers in digital media production. The [Tracks](#) program brings students to BAVC **(6)** twice a week after school throughout the entire academic year. Each month, special workshops related to public speaking and resume building, field trips and panels for industry exposure (including college campus tours), and the like are also offered to build up the nontechnical leadership skills needed for any future career.

At the time of our field site visit in September 2014, the Tracks afterschool classes were just starting, with instructors and students mostly focused on getting to know one another and the introduction of technical skills. Tracks include classes like G:URL Gamers, Sound Bytes: Beginning Audio, BUMP Records (Advanced Multimedia for Musicians), Reel Life: Beginning Video, and The Factory (Advanced Teen Filmmaking) **(7 and 8)**. No matter which track, in each class students are required to present their end-of-program portfolios at a final showcase and encouraged to pitch and complete a paid social-action project over the summer.

With so much experience facilitating the design and development of youth portfolios, it was no question

that BAVC's insights are critical to Maker Ed's Open Portfolio Project. All makers consider the sharing of their work to be an integral component of their work overall, and digital making is no different. What is different—and enlightening—are the perspectives that BAVC's instructors bring to the conversation. Most of the Next Gen program instructors and TAs are female, a diverse group of talented professionals with backgrounds and expertise not only in youth development but also in the digital media areas they're teaching. Each spoke to the challenges and approaches of creating and curating their own portfolios of work, all of which informs their students' processes, too. Having qualified women in these roles serves two very important purposes, among others: it situates them as strong leaders and mentors to the youth they teach, and it counters the societal status quo that fields like film, music, and video game design are dominated by men.

Over the years, BAVC instructors and students have experimented with a number of platforms, everything from [Pathbrite](#) to [WordPress](#), [Behance](#) to [Wix](#), [Tumblr](#), [Carbonmade](#), [SoundCloud](#), [Bandcamp](#) and [Vimeo](#). Some platforms are more popular than others, some easier to navigate than others, and some are simply better suited for displaying certain types of media, such as audio or video. The instructors, when asked about their own portfolios of work, reflected the diverse platforms, but more importantly, they brought up a few other key considerations that superseded the debate around best software. Those thoughts resonated throughout our conversations, coming through time and time again. They were:

Youth—and all people—must consider how their identities are presented to the world: for what audience, with what intention, and with what control over their image, reputation, and personal information.

A portfolio is useful not only for archiving work but also crucial for self-development. It takes skills to build and maintain, develops fluency in representing oneself, and



shows ability, voice, and work ethic.

When asked why youth should create portfolios, an abundance of thoughts, drawn from personal and professional experiences, surfaced. Instructors called out that, in today's digital age, it is particularly important to control—and curate—one's own identity and work for display. Having an online presence is an opportunity to create a brand, build an aesthetic, and contribute work to share with the greater world. These perspectives also allow youth to step beyond the classroom, for their work is important outside a grade or a teacher's judgment. Portfolios are also a way for youth to show off their skills, whether technical or soft skills. Portfolios may show a professionalism beyond the norm, even confidence in one's own work. A single project or artifact might prove that a student has completed something from beginning to end and can demonstrate their process and skillsets.

It's easy to explain why portfolios are important. It's less easy to actually facilitate the creation of them. The BAVC instructors talked through a number of challenges that they (and the rest of the field) ponder on a daily basis. Finding hosting is difficult, especially when they need portfolio platforms to be accessible, digital, flexible, and free for the youth they're serving. Platforms need to accommodate different kinds of media; they need to be stable and not disappear when the tech company is bought out; they need to have archival functionality. BAVC often receives calls from past students who ask for an old media file, but a community organization cannot keep every audio or movie clip from every student. In a perfect world, a portfolio should be owned by its creators, be linked across platforms, be able to exhibit a group identity, and even credit the organizations and mentors that contributed to its development.

Lastly, when asked about whether—and how—the process of making should be captured in portfolios, the instructors hesitated. Almost all agreed that the process students go through to reach the final product is crucial. Specifically, one instructor noted that process should be emphasized, if for no other reason than to show

that ideas do not come out fully formed and perfect. Nonetheless, the instructors debated the best way to show that process. With digital tools and digital media, does it make sense to save versions of UX designs, solely for the purpose of showing process? To someone unfamiliar with filmmaking, will rough cuts reveal something useful? One asked, "When is something just an exercise or actually a portfolio piece?"

We concluded with a half-satisfactory answer: If an important aspect of portfolios is the presentation of work, it is certainly possible to present process with a level of professionalism and sophistication that shows evolution and self-awareness. Students who design and create a portfolio are able to reflect on their own work and become comfortable explaining and showcasing what they do. With growing confidence, they have the opportunity to demonstrate their skillsets and insights to peers, mentors, and adults. And those actions increase their advocacy and ability as entrepreneurs, employees, or academics. Portfolios are both for oneself and for the world watching.

Discussion

Across these site visits a pertinent question has arisen, one that relates back to a key point from our original research brief: What do we hope to show through documenting the process of making? We assume that design sketches, prototypes, and mistakes will reveal learning that is not innate to the showcase of a final, refined product. A pile of raw materials, or a woodworking project that is tacked together, can be photographed and shown as a step in the process. However, a half-baked audio track or unedited film, as part of digital media culture and expectations, is less likely to be shown or highlighted. In these latter scenarios, are there other artifacts that reveal the same type of learning? Or will processfolios change those norms?

Sites are exploring different ways of documenting process—the struggles, iterations, and successes—with software and hardware tool platforms, with variations on facilitator prompts, and with designed spaces that help to automate documentation. These practices, as they are implemented and improved, contribute to the growing knowledge of the community and collectively may answer that key question.

Acknowledgements

The work of Maker Ed's Open Portfolio Project is made possible by generous support from the Gordon and Betty Moore Foundation. We also thank the members of the National Working Group, who provided constructive comments and valuable insights to our work.



Open 
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RESEARCH BRIEF 6

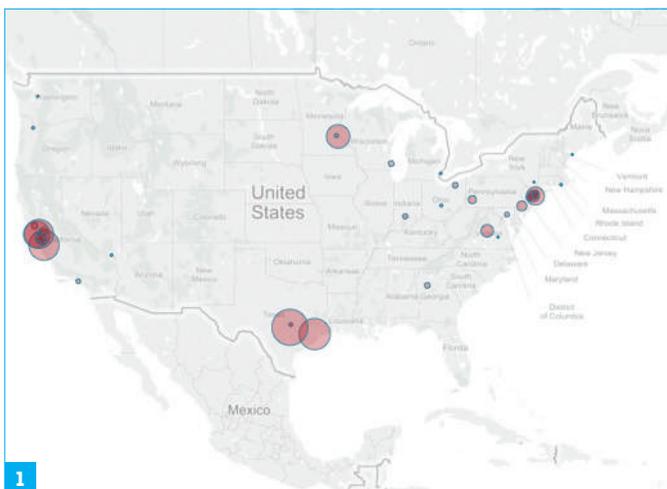
SURVEY OF MAKERSPACES, PART I

Kylie Pepler, Adam Maltese & Anna Keune, Indiana University
Stephanie Chang & Lisa Regalla, Maker Ed

Surveying Makerspaces

While makerspaces are beginning to pop up all over the globe, we currently know little about them and how they view themselves as educational spaces. Consequently, as part of the Open Portfolio Project, we reached out to an array of makerspaces, including hackerspaces, school-based makerspaces, and other community-based organizations with maker programming, to learn more about where they're situated, who they serve, and the kinds of activities in which their members regularly engage. In addition, we sought to better understand how they connect to the current policy landscape—particularly the alignment with science, technology, engineering, and mathematics (STEM) fields. This brief summarizes the responses to several sections of a broader survey (see Appendix B for a full copy of the survey) that was sent out to Maker Education Initiative field sites and allied institutions and is Part 1 of a three-part brief series summarizing the survey's results.

FIGURE 1: Map of survey responses, depicting the location and relative size of the makerspaces in terms of their estimated daily number of participants/visitors.



Who Are the Respondents?

A total of 51 youth-oriented makerspaces from across the United States responded to our survey, in addition to one site from Korea. The makerspaces reported serving a median of 450 visitors annually, with a wide range—from 50 to 850,000—of annual participants. The participating makerspaces reported that they involve a total of approximately 1.8 million annual visitors in their makerspace programming—a testimony to the growing popularity of the Maker Movement here in the United States. See **Figure 1** for a visual map of the locations of the makerspaces participating in the survey and their relative sizes.

The responding makerspaces identified as being located in one or more physical spaces, including 35% in schools (of which 2% of respondents were homeschools, 6% charter schools, 16% independent schools, and 10% public schools, and 1% international schools), 26% in after-school programs, 28% in community-based organizations, and the remaining 22% were found in a range of other settings, including low-profit, limited liability (L3C) businesses, international schools, science museums, libraries, city institutions (i.e., local government institutions), and other types of nonprofit institutions. Of these, 77% responded that they were nonprofit organizations, and an additional 6% of sites responded that they were situated in for-profit institutions.

The majority of respondents have provided maker programming for two years or less, with 16% in existence less than one year, 41% in existence for one to two years, 18% in existence for three to five years, and 26% in existence for more than five years. This bimodal distribution reflects the relative newness of many makerspaces nationally, as well as a group of maker-type organizations that have been in existence for some time but are well aligned with the larger goals and ethos of the Maker Movement.

A Makerspace by Many Names

In this report, we call all 51 sites by a general name: “makerspace.” However, we note that the sites refer to themselves by a variety of names and descriptive titles of services. In fact, only around half the sites (53%) consider themselves to truly be a “makerspace,” with sites commonly calling themselves by one or more other terms, including “drop-in space” (23.5%), teen/youth center (24%), innovation lab (22%), design lab (14%), hackerspace (10%), Fab Lab (8%), idea lab (8%), and science lab (6%), as well as a host of other titles including the following terms used by three or less of survey respondents (see **Figure 2**).

This diversity in naming is reflective of the larger Maker Movement. Making encompasses a wide variety of categories, activities, and learning approaches, which are seen in the many different naming conventions that tend to be embraced in today’s landscape. This wide range of names also highlights some of the unique foci of each space or program. However, this does raise challenges for visitors, policymakers, and researchers seeking to easily identify a relevant population of sites with programming. For our purposes, we asked sites that self-identified as makerspaces to respond to our survey.

Whom Do Makerspaces Serve?

Across all makerspaces surveyed, 42% of program participants were White, 20% were Black/African-American, 18% were Hispanic/Latino(a), 14% were Asian, 0.3% were Native American, and 5% did not fall in the given categories. While these represent the mean across all makerspaces responding, the sites vary widely in the populations they serve (see **Table 1**). This also demonstrates greater diversity than the current U.S. population, based on findings from the U.S. Census data in 2010. Additionally, the sites surveyed reported serving individuals with mental/physical disabilities, which was an average of 8.1% of the total populations served, ranging from 0–66% of the population served across sites.

- » Active-Play
- » After-School Program
- » Art Center
- » Arts Camp
- » Audio Studio
- » Children’s Creativity Museum
- » Club Home
- » Community Space
- » Creativity Lab
- » Design-Based
- » DJ Studio
- » Gallery Space
- » Hands-on Learning Space
- » Idea Lab
- » Informal Learning Environment
- » Lab
- » Learning Lab
- » Make Space
- » Maker Art
- » Maker Lab
- » Makery
- » Media Lab
- » Museum
- » Museum as Play
- » Place for Collaboration and Creation
- » Production Studio
- » Robotics Learning Lab
- » Sandbox
- » School
- » Science Lab
- » Studio
- » Tech Center
- » Teen Media Lab
- » Teen Tech Studio
- » Tinkering Space
- » Workshop

2

Collectively, this paints a picture that stands in stark contrast to the adult demographics (i.e., predominantly middle-aged, White males) attending Maker Faires or subscribing to *Make*: magazine (Maker Media, 2012, 2013a/b) that has been subject to a great deal of recent scrutiny (Buechley, 2013). We believe that the prior statistics are representative of the current demographics found in STEM fields, which have had a hard time attracting women and people of color into these fields (Intel, 2014). However, this new generation of makers looks to be more diverse and holds a great deal of transformative potential as we think about supporting these young makers across their lifespan.

What Tools and Materials Are Maker Sites Using?

Over half of the makerspaces (51%) reported laptops and computers as core tools for making and 25% also

TABLE 1: Race and Ethnicity Across All 51 Makerspaces

	US CENSUS	MAKER SITE SURVEY		
		Mean	Median	Standard Deviation
ASIAN	4.80%	14.00%	7.00%	19.00%
AMERICAN INDIAN & ALASKA NATIVE	0.90%	0.30%	0.00%	0.90%
BLACK/AFRICAN AMERICAN	12.60%	20.00%	10.00%	21.00%
HISPANIC/LATINO	16.30%	18.00%	10.00%	24.00%
WHITE	63.70%	42.00%	44.00%	30.00%
OTHER	9.30%	5.00%	0.00%	16.00%

mentioned tablets, which hints at a large proportion of making that includes digital processes or products. On these tools, 22% of the sites run multimedia software, including Adobe Creative Suite, GarageBand, and ProTools; 14% coding tools including Scratch and Code.org; and 12% 3D modeling software such as Tinkercad, Maya, and 3DTin.

Nearly 40% of the makerspaces mentioned 3D printers as frequently used tools, 26% reported using laser cutters, and 8% mentioned vinyl cutters. Everyday crafting tools and supplies—including cardboard and paper, scissors and other cutting tools, tape and glue, as well as popsicle sticks and googly eyes, among others—were reported by 39% of the sites.

To document and record making activities, 22% reported using cameras, including video, DSLR, HD, point-and-shoot cameras, and camcorders. Of these, 4% reported using smartphone cameras to record making activities.

These findings and a range of other tools and materials are summarized in **Table 2**.

Makerspace Programming

Among after-school or out-of-school programming (18% of sites), youth used these tools and materials to work on projects for an average of one to two hours per week, every day of the week or during weekends. Another 18% of other sites reported a variety of camp programs, including six to eight-week-long summer camps, school-break day programs, and one-week day camps, all that offer a diverse range of project involvement opportunities as well as access to a mix of tools, use instructions, directed challenges, and open-ended projects. Ten percent (10%) integrated maker clubs (related to robotics and design) into their flagship offering, and 8% others reported interactive exhibits (gallery spaces, activity tables, self-guided activities, etc.).

Presentation of work created by the youth at the sites was an important aspect of core maker programming. Sixteen percent (16%) reported opportunities to present work to the public on-site or through interactive family nights, exhibiting youth work at the site, organizing school-wide year-end festivals, or public workshops several times during the year. Twelve percent (12%) reported private exhibitions of youth work, such as portfolio defenses and presentations open only to a specific audience. Off-site public presentation of work (defenses) was reported by 5.9% of the responding sites. These types of sharing events included Maker Faires, Mini Maker Faires, and other local fairs and events.

Professional development opportunities, where educators shared program development insights and practiced skills with educators from other schools, were reported by 16% of sites. Eight percent (8%) reported facilitating outreach programs and workshops in neighborhoods, libraries, and other community facilities.

TOOLS, EQUIPMENT, AND MATERIALS	PERCENTAGE OF SITES
Laptops And Computers	51%
3D Printers	40%
Everyday Crafting Materials	39%
Laser Cutters	26%
Tablets	25%
Multimedia Software	22%
Soldering Irons	22%
Photo And Video Cameras	22%
Hot Glue Guns	20%
Saws, Wood, and Wood Scraps	20%
Circuitry Tool Kits	18%
Coding Tools	14%
Drills	14%
Makey Makey Kits	12%
General Hand Tools	12%
3D Modeling Software	12%
Robotics Kits	10%
Sewing Machines/Sewing Materials	10%
Metalworking Tools And Materials	8%
Vinyl Cutters	8%
Smartphone/iPod Touch	4%

TABLE 2: Most Commonly Reported Tools and Materials Across Sites

Other programs (12%) included offering internship programs, such as residency and volunteer opportunities at the site and small apprenticeship programs in coordination with other local organizations.

Conclusions

Our Open Portfolio Project site survey helped to frame our continued research and strongly informed the site visits and findings that arose from the greater field. While making is adopted as a theme, emphasis, or focus for youth educational programming at a variety of settings, it remains important to recognize and pay attention to what the field is doing, which audiences are served, and what gaps still remain. As seen through the many different materials being used and the diversity of race and ethnic backgrounds of youth at these makerspaces, both the breadth and the current inclusivity of making forms a firm foundation for future policy and educational efforts seeking to deepen learning in these spaces over time.

Acknowledgements

The work of Maker Ed's Open Portfolio Project is made possible by generous support from the Gordon and Betty Moore Foundation. We all thank the members of the National Working Group, who provided constructive comments and valuable insights to our work.

References

Buechley, L. (2013, October). *Thinking About Making*. Keynote speech presented at FabLearn Conference, Stanford University.

Intel Corporation (2014). *MakeHers: Engaging Girls and Women in Technology Through Making, Creating, and Inventing*. Retrieved from <http://www.intel.com/content/www/us/en/technology-in-education/making-her-future-report.html>

Maker Media (2012). *Maker Faire Bay Area Attendee Study*. Online. Available at <http://cdn.makezine.com/make/sales/maker-faire-bay-area-survey-09-2012.pdf>

Maker Media (2013a). *Maker Faire Bay Area Attendee Study*. Online. Available at <http://cdn.makezine.com/make/sales/MFBA%202013%20Survey%20.pdf>

Maker Media (2013b). *World Maker Faire New York Attendee Study*. Online. Available at http://makermedia.com/wp-content/uploads/2013/01/WMFNY-2014-deck_FOR-PRINT.pdf



RESEARCH BRIEF 7

Open Portfolio Project

SURVEY OF MAKERSPACES, PART II

Kylie Peppler, Adam Maltese & Anna Keune, Indiana University
Stephanie Chang & Lisa Regalla, Maker Ed

Makerspaces in the National Educational Landscape

As reflected in the prior research brief (“Survey of Makerspaces, Part I”), makerspaces are involved in offering a host of educational activities to a diverse range of youth. Today, policymakers, academics, and a number of educators find resonance with the larger Maker Movement and its potential to transform and extend existing educational efforts (Peppler & Bender, 2013). However, little is known about whether and to what extent makerspaces themselves align with such larger educational initiatives, including the STEM (science, technology, engineering, and mathematics), STEAM (Arts + STEM), and standards-based movements in education. This brief summarizes the responses to several sections of a broader survey (see Appendix B

for a full copy of the survey) that was sent out widely to Maker Education Initiative youth-oriented sites and allied institutions and is the second part of a three-part series summarizing the survey results. The focus of this research brief is on how makerspaces align their organizations and programming, as well as the key skills and practices they attempt to cultivate in their spaces.

A Survey of Broader STEM Education Initiatives

We sought to better understand the extent to which makerspaces were aware of and aligned with the national educational initiatives in **Table 1**, listed in order of most prevalent to least well aligned and/or known among makerspaces.

TABLE 1: List of National Educational Initiatives and Percentage of Makerspaces Indicating Alignment

EDUCATIONAL INITIATIVE	PERCENTAGE OF SITES THAT INDICATE ALIGNMENT		
	YES	NO	NOT FAMILIAR
Science, Technology, Engineering, and Mathematics (STEM)	94%	6%	0%
STEM + Art = STEAM	89%	9%	2%
Technology Education	79%	9%	13%
Media Education	57%	15%	28%
21st-Century Community Learning Centers (21st CCLC)	51%	11%	38%
Next Generation Science Standards (NGSS)	49%	21%	30%
Career and Technical Education (CTE)	40%	31%	28%
Common Core State Standards (CCSS) in Mathematics	38%	36%	26%
Common Core State Standards (CCSS) in Language Arts	38%	43%	19%
Information and Communications Technology (ICT)	34%	26%	40%
100kin10	4%	34%	62%

The results indicated that 100% of the participating sites were well aware of the larger STEM movement, and the vast majority (94%) agreed that it was well aligned with the goals and offerings of their site. Further, the STEAM movement followed in a close second place, with 89% of sites stating that their sites and makerspace programming aligned well with this initiative. Additionally, a majority of sites reported aligning with Technology Education (79%), Media Education (57%) and 21st-Century Community Learning Centers (21st CCLC, 51%). Additionally, just under a half of the sites said that their spaces and programming seemed well aligned to the Next Generation Science Standards (49%) and larger Digital Integration Initiatives (49%). The remainder of the educational initiatives that we polled participants on seemed to resonate with less than half of the sites. However, some of these trends may be explained in large part because of the vast number of sites that were unaware of these initiatives.

Makerspaces and Next-Generation Science Standards in Science and Engineering

Nationally, there is a growing recognition of the Maker Movement's potential to transform how and what people learn in STEM fields. As President Obama stated in his remarks on the Educate to Innovate campaign:

I want us all to think about new and creative ways to engage young people in science and engineering, whether it's science festivals, robotics competitions, fairs that encourage young people to create and build and invent—to be makers of things, not just consumers of things (Obama, 2009).

This orientation toward personal fabrication rather than blind consumerism is also seen as empowering people not just to seek out jobs in STEM or other creative fields, but to make their own jobs and industries, depending on their interests and the emerging needs they see in a rapidly changing society (Kalil, 2010). As such, we're seeing a growing number of makerspaces emerging in schools of engineering and computer science,

encouraging a new studio-based approach to traditional STEM disciplines marked by open-ended approaches to learning, rather than traditional approaches that minimize hands-on instruction and more process-based types of learning experiences.

While the data in Table 1 indicates that just under half of the sites found general alignment with the Next Generation Science Standards (NGSS Lead States, 2013), another third of the respondents were not yet aware of the initiative, given that the standards are relatively new. Consequently, we sought to better understand whether and to what extent there was alignment with the core Scientific and Engineering Practices advocated in the standards. Importantly, these practices include: (1) defining problems (for engineering); (2) developing and using models; (3) planning and carrying out investigations; (4) analyzing and interpreting data; (5) using mathematics and computational thinking; (6) designing solutions (for engineering); and (7) engaging in argument from evidence, among others that applied more generally to science.

We then asked sites to reflect on the most recent month of their programs and how frequently their youth actively participated in each of the targeted practices (see **Table 2** for a full summary of results). In general, we found that the practices most aligned with fields of engineering were the most frequently reported and seemed to resonate with more than 40% of makerspaces. Such practices included problem definition and planning and carrying out investigations, as well as designing solutions to a specified problem or task. What was somewhat surprising in the results was how rarely sites cultivated mathematics and computational thinking practices, especially given the dominant role that computer programming plays in traditional maker activities. However, when relating back to the types of making and available tools described in Brief 1 ("A Networked Vision for Sharing and Documenting"), it does follow that few of the reported maker activities actually engage or necessitate coding. This mirrors the difficulties in creating coding communities among a host of prior efforts that are being addressed through

	NEVER	1-2 TIMES PER MONTH	ONCE PER WEEK	MULTIPLE TIMES/WEEK
Define problems to investigate.	6.4%	21.3%	23.4%	48.9%
Develop and use models.	19.1%	38.3%	12.8%	29.8%
Plan and carry out investigations.	10.6%	29.8%	14.9%	44.7%
Analyze and interpret data related to their project.	25.5%	36.2%	17.0%	21.3%
Use mathematics and computational thinking.	4.3%	40.4%	31.9%	23.4%
Design solutions to a specified problem or task.	4.3%	12.8%	38.3%	44.7%
Engage in argument from evidence.	23.4%	36.2%	17.0%	23.4%

Note: Bolded percentages indicate the modal or most common response.

TABLE 2: Frequency of Sites Reporting Engagement in NGSS Science and Engineering Practices

		NEVER	1-2 TIMES PER MONTH	ONCE PER WEEK	MULTIPLE TIMES/WEEK
THINK CREATIVELY	Elaborate, refine, analyze and evaluate their own ideas in order to improve and maximize creative efforts.	4.3%	27.7%	19.1%	48.9%
WORK CREATIVELY WITH OTHERS	Develop, implement, and communicate new ideas to others effectively.	2.1%	21.3%	25.5%	48.9%
	Be open and responsive to new and diverse perspectives; incorporate group input and feedback into the work.	8.5%	10.6%	27.7%	51.1%
	View failure as an opportunity to learn; understand that creativity and innovation is a long-term, cyclical process of small successes and frequent mistakes.	6.4%	14.9%	23.4%	55.3%

Note: Bolded percentages indicate the modal or most common response.

		NEVER	1-2 TIMES PER MONTH	ONCE PER WEEK	MULTIPLE TIMES/WEEK
COMMUNICATE CLEARLY	Articulate thoughts and ideas effectively using oral, written, and nonverbal communication skills in a variety of forms and contexts.	8.5%	17.0%	19.1%	55.3%
COLLABORATE WITH OTHERS	Assume shared responsibility for collaborative work, and value the individual contributions made by each team member.	4.3%	17.0%	29.8%	48.9%

Note: Bolded percentages indicate the modal or most common response.

a number of new initiatives by [Code.org](#) and others.

Makerspaces and 21st-Century Skills

Based on our initial fieldwork and interviews, we wanted to acknowledge that makerspaces cultivate more than just STEM-related competencies and practices. Seeking to better articulate these understandings, we leveraged the work from the [Partnership for 21st Century Learning](#) (P21). P21 established a set of 21st-century knowledge and skills targeted at U.S. K-12 education, which can be accomplished by what is described as fusing the 3Rs (i.e., including traditional school subject areas like reading and mathematics) with the 4Cs, which include critical thinking, communication, collaboration, and creativity and innovation. We examined a selection from across the areas of learning and innovation skills in the P21 framework, including (1) creativity and innovation, (2) communication and collaboration, and (3) critical thinking and problem solving, as well as (4) life and career skills.

Learning and Innovation Skills: Creativity and Innovation

P21 identifies “creativity and innovation” as one of the core learning and innovation skill sets, which is well aligned with the Maker Movement and the works created by makers—ranging from fanciful steampunk works to the practical types of innovations used in hydroponics. Within the P21 creativity and innovation framework, we targeted four practices that we thought well aligned

TABLE 3 (TOP): Frequency of Sites Reporting Engagement in 21st-Century Creativity and Innovation Skills

TABLE 4 (BOTTOM): Frequency of Sites Reporting Engagement in 21st-Century Communication and Collaboration Skills

with the kinds of individual and collaborative capacities cultivated through making, including (a) elaborating, refining, analyzing, and evaluating ideas in order to improve and maximize creative efforts; (b) developing, implementing, and communicating new ideas to others effectively; (c) being open and responsive to new and diverse perspectives, incorporating group input and feedback into the work; and (d) viewing failure as an opportunity to learn, understanding that creativity and innovation is a long-term, cyclical process of small successes and frequent mistakes. **Table 3** displays the degree of resonance that sites felt with each of these four targeted practices, with nearly 50% of sites stating that they cultivate all four skills multiple times per week, demonstrating a high degree of alignment between this set of 21st-century skills and the goals and aims of the surveyed makerspaces.

Learning and Innovation Skills: Communication and Collaboration

Making oftentimes involves large and ambitious group projects that necessitate close collaboration and clear communication with peers and adults. This emphasis on communication and collaboration is another core area of the P21 framework. For the purposes of our survey, we identified two of the many areas of communication

and collaboration to see how well they resonated with makerspaces, including (a) articulating thoughts and ideas effectively using oral, written, and nonverbal communication skills in a variety of forms and contexts and (b) assuming shared responsibility for collaborative work and valuing the individual contributions made by each team member. **Table 4 (previous page)** displays the frequencies sites reported for each of these two targeted skills. Again, about half of the sites stated that they cultivated both targeted communication and collaboration skills multiple times per week, demonstrating a high degree of alignment between this set of 21st-century skills and the goals and aims of the surveyed makerspaces.

Learning and Innovation Skills: Critical Thinking and Problem Solving

Makers engage in interest-driven projects, encountering new and unique problems and necessitating innovative solutions. As such, we targeted two key areas of the P21 critical thinking and problem solving framework in our survey, including (a) using systems thinking to analyze how parts of a whole interact with each other to produce overall outcomes in complex systems and (b) solving different kinds of non-familiar problems in both conventional and innovative ways. The vast majority of sites reported cultivating systems thinking one or more

times each week, as well as solving problems multiple times per week.

Life and Career Skills

Lastly, the P21 framework targets long-term life and career skills, seeking to address the need for youth to flexibly adapt to the changing demands of the workplace in the 21st century. We targeted two of the five areas of life and career skills outlined in the P21 framework, including flexibility and adaptability as well as initiative and self-direction. Within each of these areas, we targeted three to four areas that we thought pertinent to makerspaces, including (a) adapting to varied roles, jobs responsibilities, schedules and, context; (b) working effectively in a climate of ambiguity and changing priorities; (c) incorporating feedback effectively; (d) dealing positively with praise, setbacks, and criticism; (e) utilizing time and managing workload efficiently; (f) monitoring, defining, prioritizing, and completing tasks without direct oversight; and (g) going beyond basic mastery of skills and/or curriculum to explore and expand one's own learning and opportunities to gain expertise. Each of these skills

TABLE 5 (TOP): Frequency of Sites Reporting Engagement in 21st-Century Critical Thinking and Problem Solving Skills

TABLE 6 (BOTTOM): Frequency of Sites Reporting Engagement in 21st-Century Life and Career Skills

		NEVER	1-2 TIMES PER MONTH	ONCE PER WEEK	MULTIPLE TIMES / WEEK
USE SYSTEM THINKING	Analyze how parts of a whole interact with each other to produce overall outcomes in complex systems.	12.8%	17.0%	42.6%	27.7%
SOLVE PROBLEMS	Solve different kinds of non-familiar problems in both conventional and innovative ways.	6.4%	17.0%	27.7%	48.9%

Note: Bolded percentages indicate the modal or most common response.

		NEVER	1-2 TIMES PER MONTH	ONCE PER WEEK	MULTIPLE TIMES / WEEK
FLEXIBILITY AND ADAPTABILITY	Adapt to varied roles, jobs responsibilities, schedules and context.	4.3%	29.8%	31.9%	34.0%
	Work effectively in a climate of ambiguity and changing priorities.	6.4%	23.4%	21.3%	48.9%
	Incorporate feedback effectively.	4.3%	17.0%	42.6%	36.2%
	Deal positively with praise, setbacks and criticism.	2.1%	14.9%	34.0%	48.9%
INITIATIVE AND SELF-DIRECTION	Utilize time and manage workload efficiently.	6.4%	12.8%	21.3%	57.4%
	Monitor, define, prioritize and complete tasks without direct oversight.	4.3%	25.5%	19.1%	51.1%
	Go beyond basic mastery of skills to explore and expand one's own learning and opportunities to gain expertise.	6.4%	25.5%	31.9%	36.2%

Note: Bolded percentages indicate the modal or most common response.

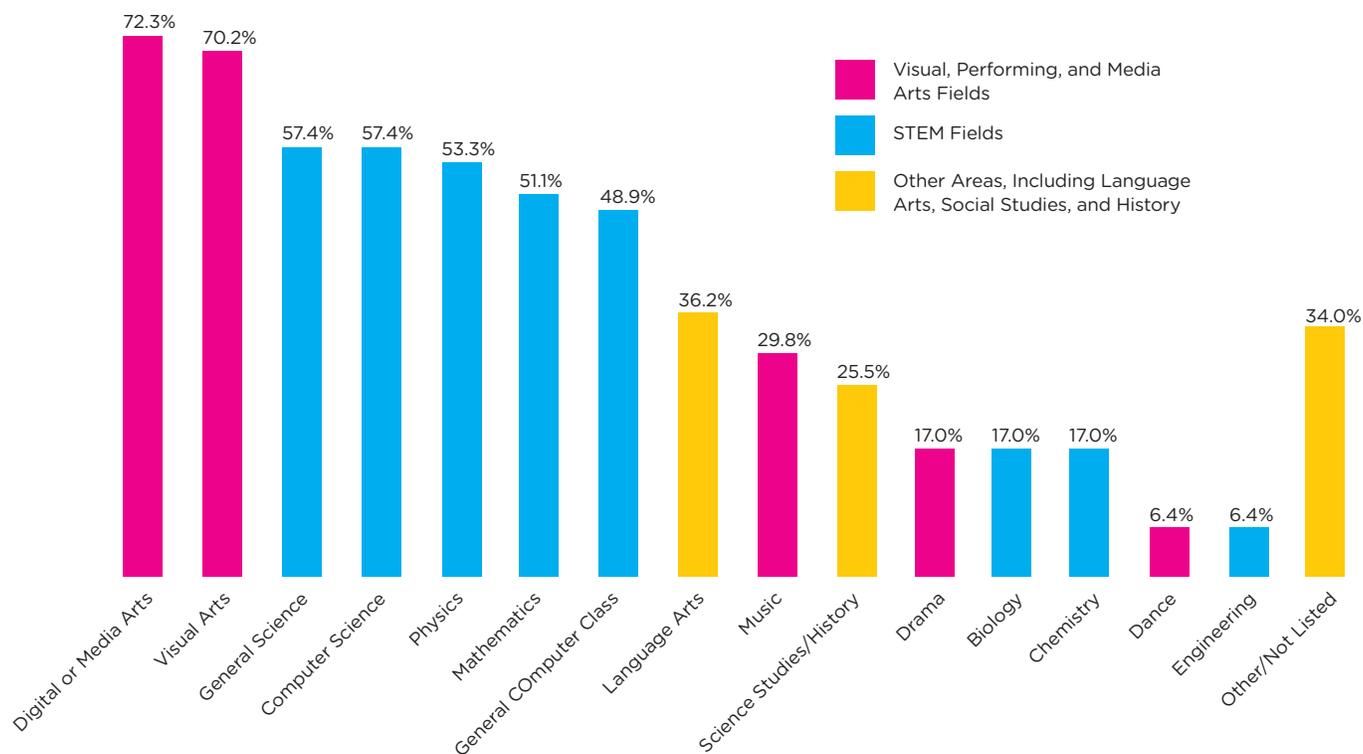


FIGURE 1: Makerspaces were asked that if their sites or programming were hypothetically to be offered during the school day, which subject areas would be offered. The percentages reported per subject are shown here.

was again reported by 50% or more of makerspaces as occurring one or more times each week. It is important to note that these skills stand in stark contrast to many educational spaces that value routine and rote memorization.

Making and Alignment with Traditional Subject Areas

To better identify where makerspaces situate in the current educational landscape, in a hypothetical scenario, we asked makerspaces that if their programs were offered in a school context, which subject areas or disciplines would most likely be offered. More than 70% of the sites replied that they would be situated in the digital, media, or visual arts, with a close second cluster found in STEM fields with sites citing general science, computer science, physics, or mathematics (**Figure 1**). This mirrors the responses in Table 1, where sites most often replied that they would situate maker programming in STEAM and/or STEM education initiatives. In addition, sites also stated that their programming aligned with general computer class, language arts, music, social studies/history, drama, biology, chemistry, dance, and engineering as well as other areas not listed on the survey. The relatively small number of connections to engineering, we believe, is related to the fact that explicit engineering classes are currently less common in K-12 schools. The other

areas that were not listed as part of our survey but noted by less than three of the respondents included: library research, practical art (which incorporates visual and digital arts with math and science), STEAM studio, innovation/tinkering time, vocational and crafting technologies, other STEM courses, technology education, robotics, world languages, media literacy/studies, stress management, and shop class/wood shop. Collectively, the survey responses paint a picture that making connects across all areas of the curriculum and is seen as particularly aligned to the arts and certain STEM fields. This aligns well with much of the public conversations about the potential of the Maker Movement to increase the STEM pipeline but also place an emphasis on the role of the arts in making.

Conclusion

Key questions that often swirl around making and learning relate to the ambiguity of making's benefits. Stakeholders, educators, parents, and administrators ask good questions, seeking evidence of its positive impact and alignment with necessary academic standards. Those who bring making into educational programming—and then proceed to transform the learning experience because of it—speak not only to the connection between making and numerous subject areas but also to the “soft,” non-cognitive skills that are developed. These skills are the 21st-century skills

highlighted here that makerspaces report engaging in: creativity and innovation, communication and collaboration, critical thinking and problem solving, and adaptability. While a clear limitation of the current work is that these are all self-reports by site administrators, the results identify key areas and general framing that deserve further research to confirm and uncover the extent to which these practices and skills are cultivated.

In addition to associating closely with NGSS standards and a wide variety of traditional academic subject areas, it is perhaps most interesting that makerspaces connect to those 21st-century skills. The large, interest-driven, collaborative projects that makers engage in require the development of such skills. Coupled with the design and creation of a portfolio—which necessitates time for reflection, opportunity for clear expression of youth voice, and a showcase of abilities—making is helping to prepare youth for any life or career pathway.

Acknowledgements

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References

- Kalil, T. (2010). *Remarks on innovation, education, and the Maker Movement*. <http://radar.oreilly.com/2010/10/innovation-education-and-the-m.html>
- NGSS Lead States. 2013. *Next Generation Science Standards: For States, By States*. Washington, DC: The National Academies Press.
- Obama, B. (2009). *Remarks by the President on the "Education to Innovate" campaign*. [Press release]. Washington, DC: White House Office of the Press Secretary. www.whitehouse.gov/the-press-office/remarks-president-education-innovate-campaign
- Peppler, K. & Bender, S. (2013). Maker Movement spreads innovation one project at a time. *Phi Delta Kappan*, 95(3), pp. 22-27.



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RESEARCH BRIEF 8

SURVEY OF MAKERSPACES, PART III

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Makerspaces and Existing Portfolio Practices

In “Survey of Makerspaces, Part II,” we introduced a broad group of makerspaces that responded to our 2014 Maker Site Survey. Makerspaces call themselves by a variety of names and have a range of educational objectives, which are explored in further depth in the prior briefs summarizing the survey results. They also serve very diverse audiences across the United States and share commonalities among the skills, focus, and practices cultivated at each site. This brief summarizes the responses to a few additional sections of our survey (see Appendix B for a full copy of the survey) and explores the existing documentation and portfolio practices across the sites, important to the goals and objectives of the Maker Ed Open Portfolio Project. Through the survey, makerspaces revealed the extent to which they value and are adopting portfolio practices in their space. Additionally, the surveys provided critical qualitative information about practices at makerspaces. This brief is the third part of a three-part series summarizing the survey results.

The Importance of Documentation and Portfolio Practices

All sites were in agreement that documentation and portfolio practices were important to their organizations, with most indicating that they were very important (45%) and the remainder indicating that these practices were moderately important (28%) to important (27%) (Figure 1). As such, makerspaces often have several spaces for documenting youth activities and support youth in creating their own, often personal, portfolio spaces. Many makerspaces aimed towards publishing documentation of as many events happening at the space as possible, in order to better advertise and recruit new members.

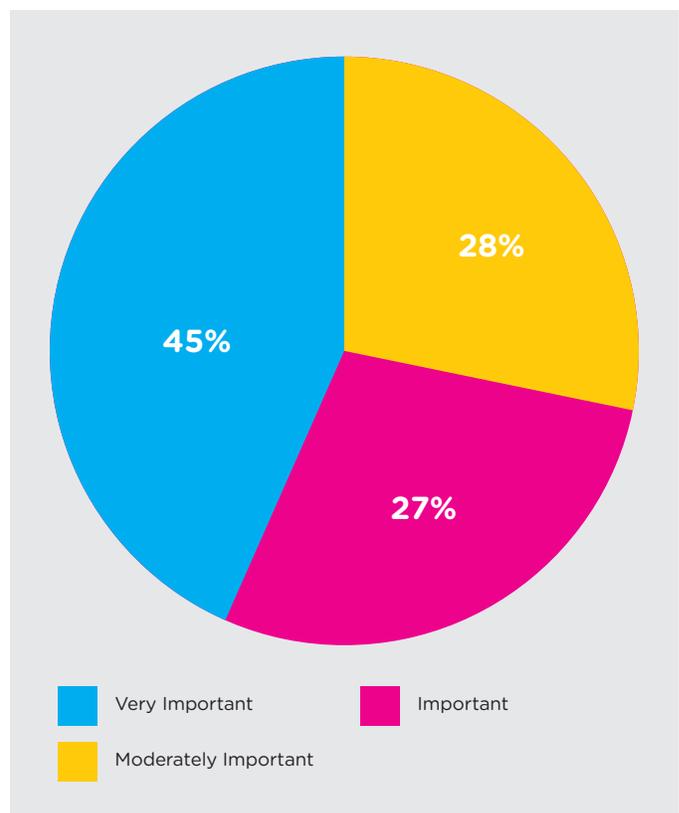


FIGURE 1: The percentage of sites indicating the varying degrees of importance of documentation and portfolio practices.

Describing Documentation and Portfolio Practices in Makerspaces

When asked whether the various makerspaces documented maker activities and projects, 86% of sites reported that they currently had a system in place. The systems involved using one particular tool or platform, a particular practice (e.g., printing and storing work in a folder), or a combination of practices. These practices

also ranged from simple forms of documentation (e.g., taking and posting a picture or screenshot of work for a flier or website) to more complex forms of documentation (e.g., posting a how-to on [Instructables](#)). Makerspaces also reported storing and exhibiting the physical artifacts in temporary and/or permanent installations, allowing documentation and sharing in local/physical spaces as well as in digital spaces.

Over half of the makerspaces (51%) reported that youth and educators (along with an occasional parent or professional photographer) frequently photograph finished works and works in progress, using digital cameras or smartphones, to share as part of portfolio practices. The colorful photographs are typically used to promote the activities of a space and to communicate ongoing work to new youth makers, maker educators and mentors, and people outside the space (e.g., non-members, funders).

Twenty-four percent (24%) of the sites also reported using video to document activities. For example, one site reported a particularly unique documentation practice of capturing and archiving stories of youth: the creation of 15-second videos to concisely summarize work. The videos were then uploaded and archived on [Instagram](#), using hashtags for easy sorting. A noted downside to this practice was the loss of hashtags and metadata when videos were downloaded from Instagram back to the hard drive. Other sites frequently reported creating longer videos (ranging from one to 10 minutes)—edited from a larger pool of photographs, videos, and project files—that shared snapshots from specific workshops and events.

Sixteen percent (16%) of the sites also asked youth to write short, reflective paragraphs about their plans, current work in progress, and completed projects. These writings included musings about material choices, tools used, successes, failures, and general project overviews. These writings were frequently augmented by photographs as well as copies and scans of project sketches at the planning stage to better illustrate making activities, efforts, attempts, and learning.

Fifty-three percent (53%) of the participating sites reported sharing their documentation publicly, and 39% reported sharing their documentation privately. Of these, 29% of the sites reported sharing documentation both publicly and privately. To publish documentation, the sites used a wide range of blogging tools, including [Blogger](#) (2%), [Tumblr](#) (6%), [WordPress](#) (8%), and [Squarespace](#) (2%). Ten percent (10%) of sites mentioned the official makerspace website and 6% reported youth's personal websites as a place for dissemination.

A number of sites mentioned sharing blog posts on social media sites, including [Twitter](#) (6%), [Instagram](#) (4%), [Facebook](#) (4%), and particular Google+ groups that are affiliated with the Maker Education Initiative. Tools used to circulate documentation internally (e.g.,

among makerspace members and staff) were [Evernote](#) (6%) and [Google Sites](#) and [Drive](#) (12%), sometimes for assessment and accreditation purposes within the institution (4%).

Many sites developed internal and private spaces for documentation and sharing. The archived activities and guides were used in different ways: by multiple members of an organization to better link program efforts, for educators to build upon past work, and for youth to reference during activities. An outstanding example of internal sharing and portfolio assessment was offered by [Envision Schools](#):

To graduate, students deliver their College Success Portfolio Defense, during which they publicly present their artifacts to teachers and peers. These portfolios contain evidence of three things for each student: her knowledge of academic content; her leadership skills; and her identity as a learner. Preparing for the defense is rigorous and challenging, and standing up in front of the defense panel is an important moment in the lives of Envision students: it is the culminating event of their high school years. The defense panel determines, again using a rubric, if the presentation "passes" or if the student needs to revise, resubmit, and defend again. With infinite opportunities to revise and improve, every student will eventually pass, when every student reaches or exceed the rubric's rigorous standards for proficiency.

Other sites focus on the creation of instructional material by adults and youth, through the documentation of step-by-step manuals of unique projects. These materials include laminated how-to instructions for projects (e.g., animation, editing a green screen film, etc.), tutorial and how-to videos, lesson plans, and workshop formats.

Approximately one-third of the sites reported documentation practices that adopt a mix of sharing both externally and internally. For example, one site asked youth to write and privately store periodic updates over a long time period, eventually publishing a polished summary via a blog post. Other notable examples asked both adults and youth to participate in the documentation process; for example, adult educators augmented youth journal entries and posted Maker Faire projects with additional and more elaborate project descriptions. The journals and write-ups by adults and youths were shared with other makerspaces as well.

More data-driven and adult-centered approaches to documentation included conducting short surveys of youth makers at the beginning and at the end of an activity or program to evaluate change over time (6% of sites). Traditional documentation practices included creating detailed engineering and science project papers, storing sheets in binders, and developing digital presentations.

Makerspaces also documented activities informally in online and offline newsletters and zines, as well as posting photographs and videos to personal media accounts, including [YouTube](#) (6%) and [Flickr](#) (6%), to back up data and project work. Six percent (6%) of the sites also reported storing student work as physical copies, including hardcopy portfolios like sketchbooks, in the space.

One of the sites reported the development of a unique digital application for capturing project information, including the tagging of tools, materials, and processes used, as well as the age of the maker. Another site reported interest in implementing a badging system in connection with portfolio creation, while a different site mentioned that specific workshop times with specific slots for documentation “helps students create and update their [DIY.org](#) portfolios” at a regular and designated time. Yet another site reported a requirement for youth members to participate and contribute to [Google+](#) community pages.

One striking observation across the work is that individual makers are frequently documented alongside their work, especially with finished works, demonstrating both a sense of pride and identity tied to the work produced. This stands in contrast to the fine arts tradition in which the work, the maker, and the process are documented separately. Maker documentation tends to have a different aesthetic and introduces issues of privacy and online safety, particularly for minors, as we consider the implications for open portfolios and current national policies for documenting and sharing work.

While blogs or collections of URLs to youth work are frequently used as central locations for documentation, PowerPoint presentations and video reels of student work are also created. These presentation formats can be shared on social media tools for purposes of marketing and can be shown to and viewed by visitors or others for a quick overview of the site’s makerspace activities.

When asked, roughly half of the sites reported having a way of collecting documentation in a central location. Makerspaces (49%) reported using an array of cloud-based services for storing and archiving photographs, screenshots, digital work, software code, and videos. These services included [Dropbox](#) and [Google Drive](#), as well as a diverse range of private and public social media tools, including [GitHub](#), [YouTube](#), [Flickr](#), [Instructables](#), [Google+](#), [DIY.org](#), and [Thingiverse](#).

Makerspaces that use documentation of youth work explicitly for assessment tended to store work in central spaces. Sites reported asking youth to submit their work to [Evernote](#) accounts and online classroom management tools. Students were asked to submit work to particular groups and to credit all participants.

Deepening Learning Through Feedback and Reflection with Portfolios

Portfolios are useful tools for deepening learning outcomes over time by supporting makers to visualize their projects and progress over time using openly networked tools (see “A Networked Vision for Sharing and Documenting”). As such, it is not surprising that nearly all sites reported providing feedback on youth projects through group or one-on-one discussion (98%). Sites also reported that youth utilized this feedback in their work (94%).

The most frequent practice related to reflection and feedback was peer review (13.7%) and included voluntary, compulsory, regular, and occasional peer review processes. Many noted that this type of “critique” of portfolios occurred before publication and was meant to help youth speak productively about another’s works. Sites also mentioned mentor-to-peer review (1.9%) with a unique practice of facilitating “rough-cut screenings,” a term from the film industry, in which professionals and staff members provided youth with suggestions for further development of video works in progress. One site noted that some youth considered feedback to be critical though difficult to provide.

As frequently as peer reviews, sites also mentioned using group feedback practices such as regular, periodic, or ad-hoc group sharing events; small group discussions at the start and end of a program; and in-person presentations. These group reflection and feedback events were reported to provide opportunities to discuss (a) what they were working on, (b) challenges they encountered, and (c) what they were planning on doing next.

Reported Barriers to Documentation and Portfolio Practices

In general, the majority of sites felt they had sufficient to excellent internet access, external storage space, and available computers/devices (i.e., they rated this “very good” to “excellent”). While some other sites reported that internet access, external storage, and available devices remain a persistent issue, the most-reported barriers to documentation and portfolio practices were (a) additional high-quality photo and video devices (61% of respondents rated the availability as “poor” or “good”) with youth frequently using their own devices at a majority of sites; (b) the number of staff available to lead, develop, and support documentation (69% of respondents rated the availability as “poor” or “good”); (c) limited access to software that supports making and documentation (57% of respondents rated the availability as “poor” or “good”); as well as (d) other issues of professional development, including a need for greater knowledge about the methods and tools

to support documentation (67% of respondents rated current knowledge as “poor” or “good”).

Reported challenges to documentation mirror the challenges identified in our field site visits and outlined in our prior research briefs (see “Maker Portfolios in School” and/or “Maker Portfolios in Informal Education”). As one survey respondent reported, documentation “has not been as successful as we wished, but our time with our students is extremely limited and therefore it is difficult to have students be reflective about process as well as be a maker.” Other challenges to open photographic documentation and public sharing of maker activities relate to complying with Federal Trade Commission (FTC) Children’s Online Privacy Protection Act (COPPA, 2013). COPPA applies to the online collection and sharing of personal information of children under the age of 13. The new rules spell out what a website operator must include in a privacy policy, when and how to seek verifiable consent from a parent, and what responsibilities an operator has to protect children’s privacy and safety online. Such restrictions are seen to hinder documentation, especially when not every guardian has been able to fully sign off on the publication and the collection of such data. Occasionally, these restrictions result in keeping documentation private to avoid potential issues.

Staff resources—such as the number of staff members, the capacity of staff to document youth work, and their level of experience with portfolios and technology—were the main areas that sites felt the need to improve on. Other resources fall under equipment for documentation, including hardware and software tools, better documentation practices, and motivations and value conceptions for documentation.

Fourteen percent (14%) of sites reported a general need for higher-quality equipment and easy-to-use tools that are integrated into the making process without distracting from making. In relation to hardware, sites mentioned the need for computers, iPod touches, iPads, tripods, as well as high-quality digital cameras and video and lighting equipment to improve the quality of the images during events. Also, sites mentioned the need for personal smartphones for on-the-fly documentation, as well as better internet access. Further, 5.9% of sites specifically pointed out the need for documentation stations to improve portfolio development at makerspaces. Here are three examples:

I would like to establish a documentation table with a white background, lights, and a mounted camera, with an easy way to transfer the images to students’ cloud-based storage accounts.

A mobile documentation center where guests can walk up to it to easily document and share.

A permanent and dedicated documentation station... would help.

In relation to software requirements to improve documentation practices, sites reported a need for platforms for youth and staff to build professional portfolios. The sites reported that these platforms should have easy and automated sharing and saving of journal entries, including steps like entering a name, taking a photo, and writing a sentence. Sites also noted the need for tools to keep track of student work over time. As videos of maker activities seemed to be popular, sites reported the need for simplified video production and post-production, especially in relation to shortening and simplifying the editing process. Further, sites required fast, age-appropriate, secure, and confidential online and cloud-based tools that provide youth with personal log-ins and access to private folders and accounts. Given the large number of youth who have personal smartphones, some of the sites reported the need for mobile applications, including software that automatically uploads pictures and videos to cloud-based storage. While many seek ways for integrating different tools and sharing documentation seamlessly across platforms, one space mentioned the need for a single platform or application.

In order for portfolio development and documentation of making to become part of the everyday activities and culture of the space, sites recommended developing a clear vision and message that address the value, purpose, goals, and long-term impact of portfolios. Further, it was suggested on several accounts that examples of appropriate and outstanding documentation might help others see why documentation is important and may lead to prioritizing documentation. We hope to address these needs within the community in our future work.

Conclusion

Overall, we find it promising that all 51 sites surveyed had thought about portfolios and documentation prior to our project. The vast majority noted that documentation was important to them, that feedback and reflection practices were crucial to youth’s learning, and even that they already had a current system for documenting in place. The qualitative responses, however, revealed that though makerspaces across the nation see the value in portfolios and documentation, that importance does not always take precedence over day-to-day operations.

Portfolios, which are a long-term and multifaceted endeavor, require clear thought and planning, and a variety of both simple and complex obstacles stand in the way of immediate implementation. As we continue with this work, these barriers are important ones to consider. Some of the challenges relate to educators needing ideas and suggestions around facilitation practices and approaches, which can be addressed through professional development opportunities and exposure to successful examples of portfolio experiences. Other barriers relate to software and hardware questions, as well as more significant needs

of staffing, capacity, and time. Ultimately, as we make the case for open portfolios being a valuable, authentic means of assessing learning, focusing in on these obstacles will pave the way to higher rates of adoption and more evidence for the importance of portfolios.

Acknowledgements

The work of Maker Ed's Open Portfolio Project is made possible by generous support from the Gordon and Betty Moore Foundation. We also thank the members of the National Working Group, who provided constructive comments and valuable insights to our work.

References

Federal Trade Commission (FTC) (2013). Children's Online Privacy Protection Act (COPPA). [public rule]. Retrieved from <http://www.ftc.gov/enforcement/rules/rulemaking-regulatory-reform-proceedings/childrens-online-privacy-protection-rule>



Open 
Portfolio
Project

RESEARCH BRIEF 9

NATIONAL WORKING GROUP MEETING SUMMARY

Stephanie Chang & Lisa Regalla, Maker Ed
 Anna Keune & Kylie Pepler, Indiana University

Maker Ed’s Open Portfolio Project has been fortunate to have an incredible National Working Group (NWG) function as an advisory and sounding board throughout the course of the project. The group spans a wide range of backgrounds and expertise, from educational research and school management to fine art, design, engineering, and technology entrepreneurship. Members of the group (see Appendix C) join in on monthly calls to hear updates, share their own work and developments, and provide insights into the progress of the project itself. The NWG also serves to further extend the impact of the project by exposing the work to the greater community while simultaneously integrating the community into the process. Their engagement and input have led the project to uncover new insights, connect with key partners, and better gauge the pulse of the greater maker education and maker portfolio communities.

When 12 NWG members convened in-person in November 2014, along with the core team from Maker Ed and Indiana University’s Creativity Lab, key staff from Maker Ed, program officers from the Gordon and Betty Moore Foundation, and special guests and speakers, the intent of the meeting was to not only share project findings but also to take measure of how the thinking around maker portfolios has grown or changed. With so many different perspectives and experiences in one room, some of the discussions took on a new light, and many informed the potential future directions of the project and research.

Emerging Themes

Across the many breakout sessions and conversations of the meeting, it was evident that all who gathered together were convinced of the vast potential that open portfolios can bring as an alternative to traditional assessment practices. When the project first began in late 2013—with much of these understandings and context exhibited in the first research brief, “A Networked Vision for Sharing and Documenting”—



it was noted that open portfolios offer an opportunity for individuals to showcase their abilities and express themselves through the use of diverse, wide-ranging digital tools. While this belief still holds true, the emerging themes uncovered in our work reveal ongoing challenges and an evolution of focus.

Sparked by preliminary analysis from research surveys and field visits, as well as a compelling keynote address from Chris Peterson, currently with MIT Admissions, and Dr. Dawn Wendell, formerly of MIT Admissions and current MIT professor in Mechanical Engineering, the meeting participants embarked on a series of conversations centered around five themes: process, engagement and social motivation, identity, assessment and transfer, and equity and diversity. The first four themes were pre-determined topics for discussion, culled from field site findings and conversations. The fifth, and perhaps most important, theme emerged from a preliminary brainstorm of key questions and topics by NWG members.

Process

In small groups, participants discussed each of the themes, sometimes addressing a suggested question head-on and other times wandering across all tangents



of the topic. For the theme of “process,” the key question used to prompt discussion was: How might youth makers begin, develop, and cultivate portfolios of work that capture not only the final, refined products but also the process of creation and their development as makers?

In assuming that portfolios can indeed function to show process and not just final products, it became clear that the experience of making and documenting needs to be carefully designed. As a designed experience, the act of creating a portfolio, or of capturing the process of making, encompasses not only the necessary or useful tools but also the space, people involved, environment, and ambiance. When facilitators and mentors are trained and available to guide youth through the experience, youth are prompted and supported to make, to document their making, and to share. A well-designed experience affords youth the skills and time to create a portfolio that serves as a documentation, iteration, and critique space. In turn, open portfolios can also become artifacts, separate but linked to the original product. And those portfolios may reflect the different interests and stances that a child naturally has, whether focused on aesthetics, fine-tuned skills, or function.

Engagement and Social Motivation

Another theme was “engagement and social motivation” with a guiding question of “What compels a youth maker, maker educators, and makerspaces to create portfolios, share them, and continue to develop them throughout the learning process?”

The group talked through the many different factors that motivate youth to create maker portfolios: program or teacher expectations, standards set by peers, and an online presence and identity, among others. Changing a portfolio’s audience may change its curated content, and

youth may engage in portfolio design and development for a specific future purpose, for example to impress prospective job employers or college admissions offices. Of note, it was highlighted—both in the meeting and in site visits—that portfolios can also be seen as part of one’s social responsibility to contribute to the growing knowledge of a community. Makers share their successes and struggles, and those learnings strongly advance the knowledge base.

Identity

Equally as important and overlapping with many of the other themes was the question of identity, specifically “How does the curation of a portfolio contribute to the shaping of identities, whether of an individual youth maker, a community, and/or a space?”

Early on in the project, it was recognized that open portfolios allow youth to curate and create their own identities. Yet, it remains to be understood how to—and if there is a best approach to—evaluate the identities presented. Short of that, researchers and practitioners debate the best tools to enable one to create an online version of oneself, as well as how to maintain and control information flow. Future work may include a deeper investigation into how portfolios reflect maker culture and youth culture, and vice versa, along with the development of practical tools to help communities consider the value and impact of portfolios.

Assessment and Transfer

The discussion around the theme of “assessment and transfer” pulled out some of the biggest questions—many of which inform our future work on open portfolios—that bring together many of the themes and investigate the ultimate purpose of portfolios.



Equity and Diversity

Participants also brought up the theme of “equity and diversity” as critical to the conversation around open portfolio implementation. If it is believed that maker portfolios will be able to demonstrate what test scores cannot—and therefore enable youth from traditionally underrepresented communities (based on socioeconomic status, gender, ethnicity, disability, or other) to step beyond the constraints of academic testing standards and show off their abilities and voices—our ongoing research must focus on these audiences and exist within these settings.

Our representations and definitions must also be inclusive and supportive of all groups and consider the many different opportunities that makers seek to engage with. Our research has thus far seen a wide range of portfolio engagement in youth-oriented maker programs and makerspaces. Some are just beginning to think about portfolios; others have it ingrained in their programs and expectations. If future project work can succeed at providing access and opportunities for youth to make portfolios and develop confidence in their abilities, we will have significantly impacted the wider education conversation.

Future Steps

These themes arose time and time again throughout the meeting, as part of hands-on making workshops, where participants designed, prototyped, and documented solutions to each other’s travel challenges, and/or in breakout sessions that focused on narrowed areas. A significant portion of the second day of the meeting brought together participants in groups around the following three articulated questions.

Define a portfolio: What are the different types and what learning goals are associated with each type?

Design a portfolio for the purposes of access and opportunity: What factors should be considered and what tools could be used?

Create a lifetime portfolio workflow: What is different at various ages and how is the portfolio valued (personally, in school, and out of school)?

Each of these discussions drew out and clarified existing assumptions about portfolio design and implementation in educational settings. For instance, it is generally believed that portfolios are a collection of work, though they may begin with a single project. Also, all deemed access and equity to be an integral component of our research, leading to a more defined focus on it in future work. These conversations forced us to think about the most important aspects of this project and where this research can make the most impact.

We conclude this phase of the Open Portfolio Project, encouraged and motivated by the vibrant response and supportive community, eager for progress and developments. Though this portfolio system is a complex endeavor, it is clear that it must serve a multitude of audiences, be open and adaptable to all stages and levels of curation, maintain an openness that is critical to the Maker Movement and youth agency, and be shared in a wide variety of formats. A sense of urgency is also palpable: the opportunity that maker portfolios hold cannot be taken advantage of fast enough, whether by informal education practitioners, in-school administration, educational researchers, or college admissions offices.

We look to move forward with this work, renewing our focus on facilitating the making of portfolios with youth who may benefit most from alternative assessment. Their motivations, means of engagement, and needs will resonate across the wider maker and educational communities.

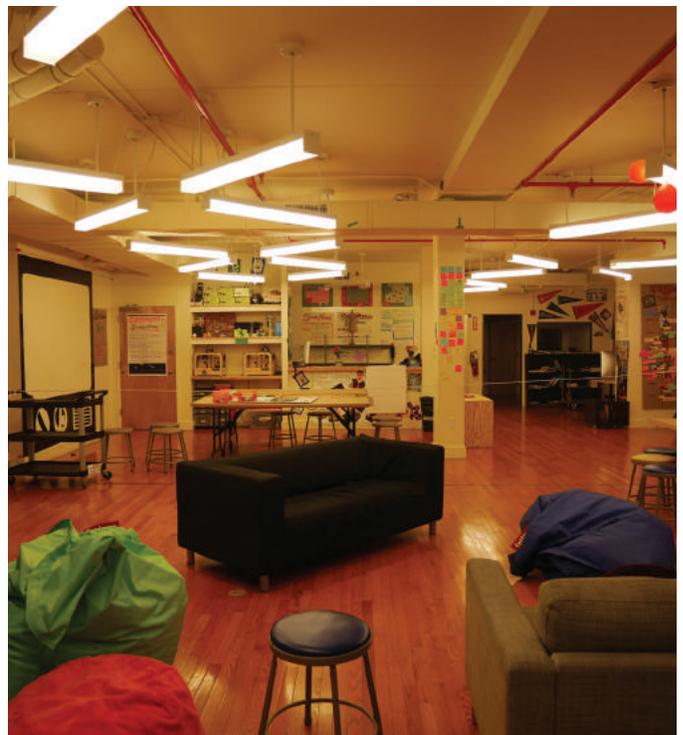
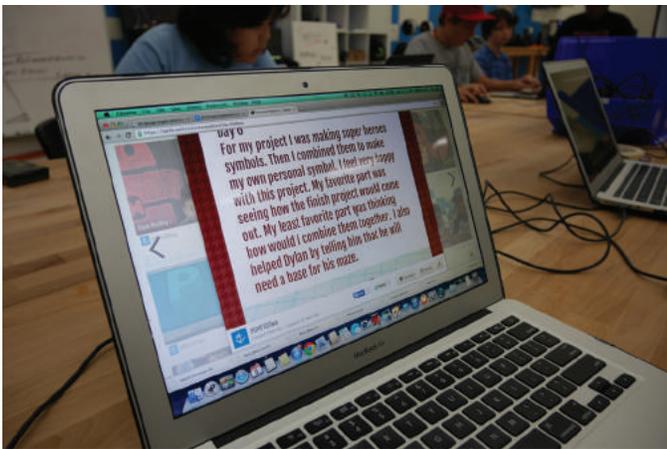
Acknowledgements

The work of Maker Ed’s Open Portfolio Project is made possible by generous support from the Gordon and Betty Moore Foundation. We also thank the members of the National Working Group, who provided constructive comments and valuable insights to our work.

MAKER SITE VISITS/VERSION 1.1 (JANUARY 2015)

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This appendix outlines the maker sites that actively participated in the Maker Ed Open Portfolio Project field site research. The sites were carefully selected, based on a site representative's responses to the maker site survey that was widely circulated at the beginning of the project. The responses indicated that visits and research at these sites would serve to provide substantial accounts of ongoing portfolio practices and conceptualization of open portfolios, all of which could be shared with a wider community of practitioners.



	SITE NAME	SITE TYPE	LOCATION	CORE PROGRAM	DEMOGRAPHICS
1	Children's Creativity Museum	Museum	San Francisco, CA	Animation studio, music studio, design studio; rapid prototyping; field trips	18% Asian 4% Black/African American 10% Hispanic/Latino 2% Native American 57% White 6% Other 3% Not Reported
2	Chevron Maker Annex, Children's Museum of Houston	Museum	Houston, TX	Exploring STEM ideas through making in self-guided activities; facilitated weekly programming; facilitated in-depth workshops	6% Asian 25% Black/African American 30% Hispanic/Latino 1% Native American 38% White
3	Millvale Community Library	Library	Pittsburgh, PA	Weekly drop-in program to take apart, fix, recreate anything; small-group artist apprenticeships between local artists and teens; tool-lending library operation	5% Asian 30% Black/African American 3% Hispanic/Latino 2% Native American 60% White
4	Digital Harbor Foundation Tech Center	After-school program	Baltimore, MD	Semester-long introductory programming for high school youth (Maker Foundation); elementary programming to develop design and creativity confidence (Maker Labs)	10% Asian 60% Black/African American 5% Hispanic/Latino 25% White
5	DreamYard/Parsons The New School of Design collaborative	After-school program and pre-college preparation program	New York, NY	Visual arts; theater; hip hop; arts and activism; maker; fashion; digital music; poetry; photo/video; open studio	25% Black/African American 70% Hispanic/Latino 5% Not Reported
6	Bay Area Video Coalition	After-school program	San Francisco, CA	Youth media arts classes with public presentations of student-designed projects; paid internships or capstones	18% Asian 20% Black/African American 30% Hispanic/Latino 10% White 22% Other
7	Lighthouse Community Charter School	Charter school	Oakland, CA	Making elective; robotics elective; after-school making class; Maker Faire exhibitions; parent/family maker events; school-wide sharing events; professional development at other schools	5% Asian 7% Black/African American 85% Hispanic/Latino 2% White 1% Not Reported
8	Monticello High School	Public school	Charlottesville, VA	Maker clubs; robotics; internship program; maker library	1% Asian 20% Black/African American 30% Hispanic/Latino 2% Native American 47% White
9	Ravenswood City School District	Public school	East Palo Alto, CA	Introductory and advanced courses and classes offering individual projects related to STEM, design thinking, coding, and robotics	10% Black/African American 88% Hispanic/Latino 2% White
10	Marymount School of New York Fab Lab	Independent school	New York, NY	Project-based classes on digital design and fabrication; physical computing, and computer programming; public workshops (maker days)	10% Asian 5% Black/African American 15% Hispanic/Latino 70% White

MAKER SITE SURVEY

This appendix presents a blank maker site survey. Included are all questions that respondents were asked to answer, covering 10 sections: (1) Introduction and Consent, (2) Contact Information, (3) Documentation Practices, (4) Access to Tools and Resources for Documentation, (5) Feedback and Reflection Practices, (6) Maker Activities, (7) Site Description, (8) Making and Education, (9) Research and Evaluation, and (10) Final Questions and Comments.

1. INTRODUCTION AND CONSENT

INSTRUCTIONS

Thank you for agreeing, and taking the time, to participate in this survey. The data collected through this survey will help us better understand the landscape of maker culture and how documentation of projects in makerspaces takes place. Additionally, this survey will help us to further our research into the use of portfolio systems to support learning by helping us to select sites for further inquiry. It should take you 30–40 minutes to complete this survey.

After agreeing to the consent form, you may save your progress and return to the survey at any time via a link emailed to you from SurveyGizmo. There will be an orange bar with “Save and continue survey later” on each page that you may click on to enter your email address for a continuation link.

Your responses will remain strictly confidential. This research is being conducted by Dr. Kylie Peppler at Indiana University in collaboration with the Maker Education Initiative. Please direct any questions or report a research-related problem to Dr. Kylie Peppler at kpeppler@indiana.edu or (812) 856–8381.

The following text is for Informed Consent; the data you provide will be confidential and participation in this survey is fully voluntary. You will be asked to read the statement to this effect and confirm your understanding of that statement by checking a box.

Thank you again for your participation.

RESEARCH PROCEDURES

This survey is being conducted to better understand the landscape of maker culture and how documentation of projects in maker-related programs and makerspaces takes place. If you agree to participate, you will be asked to complete an online survey that will take 30–40 minutes.

RISKS AND BENEFITS

There are no foreseeable risks for participating in this research. There are no benefits to you as a participant other than to advance research in the use of portfolios to support learning.

CONFIDENTIALITY

The data in this study will be confidential. Identifying information will not be disclosed in any publications that result from this study. Only the research team will have access to the data collected during this study. Survey data will be stored on a password-protected external hard drive, which will be maintained in a locked office at Indiana University. We will keep the data for five years following the study, at which point all data will be erased from the hard drive.

PARTICIPATION

Your participation is voluntary, and you may withdraw from the study at any time and for any reason. If you decide not to participate or if you withdraw from the study, there is no penalty or loss of benefits to which you are otherwise entitled. There are no costs to you or any other party.

CONTACT

If you have any questions regarding your rights as a research subject or your participation in this research, please contact the Indiana University Human Subjects Office at (800) 696-2949 or (812) 856-4242.

This research has been reviewed according to Indiana University Human Subjects Office procedures governing your participation in this research.

By clicking the box below, you indicate that you have read and understood the above Informed Consent statement and you agree to participate in this survey.

() I have read and understand the above Informed Consent Statement and agree to participate in this survey.

2. CONTACT INFORMATION

1. Site name
2. Street address
3. City
4. State
5. Zip code
6. Site URL
7. Name of person filling out this survey
8. What is your role within the organization?
9. Email
10. Phone
11. If different from the person filling out this survey, who is the site administrator/lead administrator (name and title)?
12. Administrator's email
13. Administrator's phone
14. In order to network with other sites, would you like your site to be added to the Maker Education Initiative's public directory?
 - Yes
 - No
15. Would you like the primary contact person's name (site administrator or person filling out the survey) to also be included in the directory?
 - Yes
 - No

3. DOCUMENTATION PRACTICES

16. Does your site currently have a way of documenting maker activities and projects? This may involve one particular tool or platform, a particular practice (e.g., printing and storing work in a folder), or a combination of the above. It can also range from simple forms of documentation and practices (e.g., taking and posting a picture or screenshot of work for a flier or website) to more complex forms of documentation (e.g., posting a how-to on Instructables.com).
 - Yes
 - No

17. Please provide a brief description of how you

document activities and projects at your site, who is engaging in documentation with which tools, and how documentation is being utilized.

18. How important are documentation practices at your site?

- Not very important
- Moderately important
- Important
- Very important

19. Do you currently have a way of collecting this portfolio documentation in a central location?

- Yes
- No

20. If yes, please describe.

21. If possible, please provide a link to this site or to a sample of work documentation, such as a blog or YouTube video/channel.

22. If documentation is done via other means not listed above, please briefly describe them.

4. ACCESS TO TOOLS AND RESOURCES FOR DOCUMENTATION

23. How sufficient are your resources for documentation?

	POOR	GOOD	VERY GOOD	XLNT
Our site's distributed Internet access is...				
Our available server or external storage space for electronic files is...				
Youths access to electronic storage space for large video, photo, or other project files is...				
The number of computers or portable electronics available for everyone to use is...				
The number of high quality video and photo devices to support documentation is...				
The number of staff we have to lead, develop, and support documentation is...				
Our site's access to software that supports making and documentation is...				
Our site's access to online communities that support making and documentation is...				
Our staff's knowledge about creative commons is...				
Our staff's knowledge about methods and tools to support documentation is...				
Our staff's regular and easy access to electronic storage space is...				
Our youth's regular and easy access to electronic storage space is...				

24. Based on your observed barriers or potential conduits toward portfolio-documentation practices, what particular tools, resources, or technologies might your site's staff need to improve documentation and portfolio practices?

25. To what extent do youth use their own devices (whether phones, smartphones, tablets, computers, etc.) to document their work?

- Never
- Sometimes
- Frequently
- Always

5. FEEDBACK AND REFLECTION PRACTICES

26. Is feedback provided on youth work (either formally or informally through discussion or conversation)?

- Yes
- No

27. Do youth utilize this feedback in their work?

- Yes
- No

28. Are there any other ways that group reflection and feedback occur?

- Yes
- No

29. If yes, please describe.

6. MAKER ACTIVITIES

30. Please describe your site's core programming and flagship offerings, as well as any important but occasional offerings (such as programming or special events offered monthly, annually, or biannually).

31. What are the most commonly used tools and materials in your space or program?

32. Does your site or organization participate in any of the following? Please check all that apply.

- World Maker Faire
- Regional or Mini Maker Faire
- Any arts or crafts fair or festivals
- Any science or engineering fairs
- Open houses or family days/nights offered by your organization or community
- None of the above

7. SITE DESCRIPTION

33. Please briefly describe your site (150–200 words).

34. Type of organization or institution. Please check multiple if necessary.

- For profit
- Nonprofit
- Public school
- Charter school
- Independent school
- Community organization
- After-school program

- Home school
- Other

35. How long have maker programming (or related events and activities) at your site been operating?

- Less than 1 year
- 1–3 years
- 3–5 years
- More than 5 years

36. Which months are your site open? Please check all that apply.

- Year-round
- January
- February
- March
- April
- May
- June
- July
- August
- September
- October
- November
- December

37. Estimated daily number of participants in the program.

38. Estimated annual number of participants in the program.

39. Using the most recent full/regular week of your program as a reference, please provide your best estimates for the following:

Asian	0% _____ 100%
Black/ African American	0% _____ 100%
Hispanic/Latino	0% _____ 100%
Native American	0% _____ 100%
White	0% _____ 100%
Other	0% _____ 100%

40. What are the primary terms you use to identify and refer to your site?

- Makerspace
- Hackerspace
- Drop-in space
- Teen/youth center
- Fablab
- Design lab
- Idea lab
- Science lab
- STEM
- STEAM
- Other

41. Please share a photo(s) of your space (inside and/or outside), a high resolution logo, and/or any sample projects created by your participants. There is a 1MB file size limit per image.

8. MAKING AND EDUCATION

42. Do your making programs align with any of the following effort? Check all that apply.

	YES	NO	NOT FAMILIAR
Science, Technology, Engineering, and Mathematics (STEM)			
Art+STEM (STEAM)			
21st Century Community Learning Centers (21st CCLC)			
Career & Technical Education (CTE)			
Technology Education			
Information and Communications Technology (ICT)			
Media Education			
Digital Integration			
Common Core State Standards (CCSS) in Language Arts			
Common Core State Standards (CCSS) in Mathematics			
Next Generation Science Standards (NGSS)			
100kin10 (providing America's classrooms with 100,000 excellent STEM teachers by 2021)			

43. Please reflect on the most recent month of your program. How frequently did your youth actively:

	NVR	1-2X/ MO	1X/ WK	MULT. X/WK
Be open and responsive to new and diverse perspectives; incorporate group input and feedback into the work				
Engage in argument from evidence				
Articulate thoughts and ideas effectively using oral, written, and nonverbal communication skills in a variety of forms and contexts				
Plan and carry out investigations				
Utilize time and manage workload efficiently				
Assume shared responsibility for collaborative work and value the individual contributions made by each team member				
Analyze how parts of a whole interact with each other to produce overall outcomes in complex systems				
Define their own problems to investigate				
Go beyond basic mastery of skills to explore and expand one's own learning and opportunities to gain expertise				
Develop and use models				
Monitor, define, prioritize and complete tasks without direct oversight				
Develop, implement, and communicate new ideas to others effectively				
Analyze and interpret data related to their project				

Work effectively in a climate of ambiguity and changing priorities				
Solve different kinds of non-familiar problems in both conventional and innovative ways				
Design solutions to a specific problem or task				
Incorporate feedback effectively				
Elaborate, refine, analyze, and evaluate their own ideas in order to improve and maximize creative efforts				
View failure as an opportunity to learn; understand that creativity and innovation is a long-term, cyclical process of small successes and frequent mistakes				
Use mathematics and computational thinking				
Adapt to varied roles, jobs responsibilities, schedules, and contexts				
Deal positively with praise, setbacks, and criticism				

44. Career Readiness Through Education. If your site or programs were to be offered during the school day, in which of the following subject areas or disciplines would they most likely be offered? Check all that apply.

- Visual arts
- Music
- Drama
- Dance
- Digital or media
- Mathematics
- Language arts
- General science
- Biology
- Chemistry
- Physics
- Social studies/history
- General computer class
- Computer science
- Other

9. RESEARCH AND EVALUATION

45. Is research or evaluation work currently being conducted at your site, either internally or by another external agency?

- Yes
- No

46. Please describe.

47. Has your site ever conducted an evaluation or been involved in a research study?

- Yes
- No

48. If yes, please describe.

49. Would you be interested in having your site or organization participate in an upcoming research study?

- Yes
- No
- Maybe

10. FINAL QUESTIONS AND COMMENTS

50. Do you have anything else you would like to add related to the questions and topics covered in this survey, or do you have any questions you would like to direct to us?

NATIONAL WORKING GROUP MEMBERS

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This appendix includes all of the individuals who helped to make this work possible. Included are: (1) keynote speakers of the November 2014 National Working Group meeting of Maker Ed’s Open Portfolio Project at the Gordon and Betty Moore Foundation in Palo Alto, CA; (2) the program officers of the Gordon and Betty Moore Foundation, who generously supported this work; (3) the core team members; and (4) our National Working Group members. All are listed alphabetically.

Keynote Speakers

Moore Foundation Program Staff



CHRIS PETERSON
Massachusetts Institute of Technology



DAWN WENDELL
Massachusetts Institute of Technology



AANIKA CARROLL
Gordon and Betty Moore Foundation



JANET COFFEY
Gordon and Betty Moore Foundation

Core Team



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LISA REGALLA
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LEIGH ABTS
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College Park



CHRISTINA CANTRILL
National Writing Project



GI FERNANDO
Techlightenment



SHELLEY GOLDMAN
Stanford Graduate
School of Education



ERICA ROSENFELD HALVERSON
University of Wisconsin,
Madison



BUD HUNT
St. Vrain Valley School
District



HILLARY KOLOS
DreamYard Project



BOB LENZ
Envision Schools



SUSAN HARRIS MACKAY
Portland Children's
Museum



DANIELLE MARTIN
Intel Computer
Clubhouse Network



JOHN POTTER
London Knowledge Lab



JESSICA ROSS
Project Zero, Harvard
Graduate School of
Education



ANDREW SLIWINSKI
Mozilla Foundation,
formerly DIY.org



TIFFANY TSENG
Massachusetts Institute
of Technology Media Lab



JESSICA WALKER
Parsons The New School
for Design



MARCELLA KLEIN WILLIAMS
Solve for Pattern,
Clinton Global Initiative
America



MakerEd



GORDON AND BETTY
MOORE
FOUNDATION