

Connected portfolios: open assessment practices for maker communities

Connected
portfolios

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Abstract

Purpose – In contrast to traditional portfolio practices that focus on the individual, this paper aims to reenvision portfolio practices to encompass sociocultural aspects of learning by considering how young makers, both in- and out-of-school, imbue digital cultural practices into the documenting and showcasing of their work, as well as observe the extent to which their portfolios are used to build community inside and outside their local settings.

Design/methodology/approach – Drawing from a connected learning approach, the authors engaged in qualitative and ethnographic study of youth's digital maker portfolios in an out-of-school and a school-based makerspace. Through qualitative and thematic coding of portfolio walkthroughs, the authors identified four underlying characteristics within portfolio artifacts (i.e. personal and shared projects) and capturing practices (i.e. personal and shared capturing practices) that differently presented projects.

Findings – The analysis showed that portfolios that included shared productions and shared portfolios (i.e. projects and portfolios contributed to by more than one youth) and that were shared in open-ended ways across communities valued connected learning principles. These connected portfolios made community building within and beyond maker-educational communities of the young makers possible. In particular, openly shared and collaboratively captured work showed individual achievements (e.g. projects and techniques) and made visible connective and social engagement (e.g. opportunities for feedback and refinement, possibilities to narrate work to multiple audiences).

Originality/value – This paper has implications for the design of portfolio assessment in makerspaces and expands the role of portfolios as a way to capture individual and cognitive achievements alone toward connected community-building opportunities for youth as well as maker-centered settings within and beyond the youth's local maker-centered settings.

Keywords Connected learning, Portfolio assessment, Maker education, Connected portfolios, Makerspaces, Community building, Out-of-school

Paper type Research paper

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Introduction

Maker education, a movement adapted from out-of-school settings (Peppler *et al.*, 2016) that infuses crafts-based learning with technological inventiveness, offers a compelling context for exploring how online portfolios can act as powerful tools for building communities beyond a learner's setting. Embracing openness (i.e. public-facing) as a design principle of maker portfolios can help support assessments that track development across longer periods of time and across multiple digital platforms. Furthermore, recognizing youth digital culture practices as important motivators for capturing and assessing portfolios can foster professional community building while recognizing the unique contributions youth-driven making can bring to learning (Keune *et al.*, 2017; Peppler and Keune, 2019).

Traditionally, portfolios are used in educational settings to showcase the cognitive development of an individual (Mills, 1996; Niguidula, 1993), largely excluding sociocultural aspects of learning that attune to the collaborative and contextual factors that contribute to learning. Connected learning theory, which highlights the interconnections between supportive relationships, youth interests and connections to a range of opportunities, offers a lens through which to understand the more social and community-oriented aspects of a learner's development, including the ways youth engage and share their interests within communities of practice (Ito *et al.*, 2013, 2020). To reenvision portfolio practices in ways that encompass sociocultural aspects of learning, we need to consider how young makers, both in- and out-of-school, imbue digital cultural practices into the documenting and showcasing of their work, as well as observe the extent to which their portfolios are used to build community inside and outside their local settings. From this understanding, design recommendations for moving toward digital maker portfolios that account for the sociocultural nature of collectively produced work can be drawn.

To theoretically advance the portfolio curation process from a connected learning perspective, we engaged in ethnographic study of youth's digital maker portfolios in an out-of-school and a school-based makerspace. We conducted portfolio walkthroughs with youth about their experiences of capturing and sharing hands-on physical projects using digital online tools and downloaded their portfolios. Through qualitative and thematic coding (Creswell and Creswell, 2018) of portfolio walkthroughs and portfolio entries, we identified four underlying characteristics within portfolio artifacts (i.e. individual and shared projects) and capturing practices (i.e. individual and shared capturing practices) that differently presented projects inside and outside of the school and out-of-school makerspaces. Our analysis showed that portfolios that included shared projects and shared documentation (portfolios owned by more than one youth) and that were shared in open-ended ways across communities made community building within and beyond maker-educational communities possible, including making visible technical and social engagement, presenting greater opportunities for feedback and refinement and possibilities to narrate work to multiple audiences. Peer reviews of youth creative production across online settings presented rigorous and productive assessments, including constructive sharing of production processes that went beyond reflections of maker processes by including valuable comments and resources for future personal and community productions. This has implications for the design of portfolio assessment in makerspaces and expands the role of portfolios from community-building tools inside the makerspace to encompass opportunities outside the makerspace.

Connected learning: making connections across settings and making progress or achievement visible across settings

Connected learning is a theory of learning that emphasizes how supportive relationships can draw on youth interests to create connections to a range of academic, civic- and

career-related opportunities (Ito *et al.*, 2020). As an ecological model for learning, connected learning draws from youth interests to emphasize how the social and cultural dimensions of learning shape meaningful and sustained learning experiences.

Connected learning environments emphasize learning that is *connected across settings* so that young people can access learning opportunities beyond their immediate learning context. Making connections across settings means that learning can be viewed as connected across the many contexts in which young people interact, including the home, school, community and online. The connections across settings element also relates to findings from broader connected learning scholarship, which shows that a successful future career is often tied directly to the building and cultivation of an interconnected network of peers, mentors and the organizations to support learning across contexts (Sefton-Green *et al.*, 2019). Capacity and social capital building are thus foundational to development as a connected learner as learning becomes less siloed, less individually and cognitively focused and more dependent on the relationships and brokering connections between sites for learning.

Several design principles support the connected learning element of connections across settings, including: *coordinating across settings*, *brokering across settings*, *openly networked infrastructure* and, of particular interest for this portfolio-based study, *progress or achievement is visible across settings*. In connected learning environments, progress or achievement is made visible across settings as learners move across different learning environments and bring their work with them as they interact within different contexts. We consider progress or achievement in this sense to be how young people track and showcase their work in ways that shape their identities and signal their membership in particular communities of practice (Ito *et al.*, 2020). The present research extends theorization of the productive intersections of material and digital production, capturing and sharing toward understanding implications of youth-digital-culture-driven open portfolio assessment as part of designing a connected learning ecosystem.

Makerspaces as connected learning environments

Many makerspaces have elements of connected learning environments that have promise for supporting interest-driven learning using a combination of familiar and new digital technologies (Pepler and Bender, 2013; Pepler *et al.*, 2016). Emerging from out-of-school settings, making and makerspaces have gained traction within schools, where administrators encourage new spaces or restocking of old spaces with new equipment (Berland, 2016). Within makerspaces, while youths create personally meaningful projects, learning unfolds as they get to know the materials that they craft with and the peers with whom they are sharing their work (Halverson and Sheridan, 2014). It is at the intersection of designing and sharing where making produces interest-driven learning communities, one project at a time (Sheridan *et al.*, 2014).

Engagement with maker projects is a form of constructionist learning, an approach where youths explore and internalize the inherent aspects of the materials with which they are working (Pepler *et al.*, 2016), framing materials as *objects-to-think-with* (Papert, 1993). Designing with an object-to-think-with can build on the passions and interests of youth, helping youth form personal relationships with knowledge and ways of knowing (Turkle and Papert, 1990; Kafai, 2005). This kind of learning does not happen in a social vacuum. As youths create, they are situated within a social ecology, with other youth producing projects around or with them. Within this sociomaterial context, documenting and sharing learning experiences and projects can make learning and personal processes of learning visible (Bers, 2008; Chapman, 2009). Sharing is a central tenet within constructionist approaches, as it

reciprocally serves the purpose of deepening the engagement in construction (Resnick, 2007).

Equally, sharing is also a key aspect of connected learning environments in which the sharing of artifacts is part of the learning process (Keune *et al.*, 2020; Keune *et al.*, 2021). The connected learning framework has been a productive lens for research on makers and makerspaces (Penuel *et al.*, 2019), showing how youths are engaging in hands-on work that furthers their interests, builds their networks and extends to opportunities beyond their immediate environments. Calabrese Barton *et al.* (2017) further highlighted how critical, collective and connected forms of engagement supported youth within a makerspace toward more equitable framing that accounted for youths' personal histories within makerspaces. Particularly those spaces that make it possible for youth to capture and share their projects within the makerspace as well as through online technologies (e.g. social media channels) that are associated with the space present opportunities for sustained engagement with domains associated with making also beyond the makerspace community (Keune *et al.*, 2017; Pepler and Keune, 2019).

Promise of portfolios assessment in makerspaces

Traditional portfolio assessment has mainly focused on supporting learners to take ownership of their own learning and to improve curricular activities through teacher-student conferences and showcasing an individual's best achievements (Mills, 1996; Niguidula, 1993). Portfolio assessment originated from the historical precedent of arts based portfolios (Gardner, 1989). As a response to the increased pressures of accountability, portfolios were seen as a hopeful alternative to standardized testing and a way to provide a richer picture of student learning (Niguidula, 1993; Mills, 1996). Typical portfolio assessment processes tightly couple instruction and assessment to increase ownership over learning and to position portfolios as learning tools (Lamme and Hysmith, 1991; Love *et al.*, 2004).

Identifying assessment tools and practices for maker-educational contexts is an important concern within maker-educational contexts because assessments within these spaces promises opportunities for understanding ongoing individual and community learning as well as information toward program evaluation and educator training (Petrich *et al.*, 2013; Chang *et al.*, 2019; Wardrip *et al.*, 2021). In the present study, connected learning frames the approaches toward identifying productive practices for capturing and sharing the young makers' own creative practices. The use of portfolio tools within creative maker-centered contexts is also an opportunity for capturing collaborative engagement among more than one youth (Lui *et al.*, 2016). Such collaboration-centered explorations are particularly interesting for the present study, because they point at the versatility of using portfolios for capturing making as it authentically happens.

Understanding how to successfully capture the richness of engagement in makerspaces promises to broaden opportunities, because not only products and individual achievement but also collective actions in production-centered processes can become visible to people outside the makerspace and can be leveraged for community building. The experiences which youth document today could dramatically shape the opportunities that they access tomorrow. For instance, when youths share projects online, these projects continue to live on and become searchable and commentable to communities across spaces and timescales, turning into connected portfolios that may be shaped by their audiences. To foster the promise of portfolios to represent youths' role in society, it is imperative to consider how portfolios act as community building tools inside and outside makerspaces.

Methodological approach

To study youth maker portfolios, we performed a five-year-long qualitative inquiry in two makerspaces with continuous space-wide portfolio efforts: an out-of-school and a high school makerspace in the eastern USA. The sites were drawn from responses to a makerspace survey related to portfolio practices from 51 school and out-of-school makerspace administrators (Pepler *et al.*, 2015). Based on an ethnographic engagement with ten sites that stood out in regard to their portfolio practices, we selected two sites for in-depth study, one out-of-school and one school makerspace, because of the particular proliferation of their portfolio processes across the sites and the use of portfolio tools and processes across a longer period of time. Analyzing the production and portfolios practices of one out-of-school and one school site was aimed to help understand the role of portfolios as assessment tools beyond individual cognitive measures.

Makerspace and portfolio process at the out-of-school and school makerspace

The out-of-school space offered programs that served youth (age 8–18 years) through a variety of course formats related to digital fabrication and media production. Across all participants, the youth included a majority of male participants (i.e. 35% female, 65% male participants). The majority of the youths were black, followed by white, Asian and other racial or ethnic backgrounds. A small group of students were Latinx. Across the makerspace, the portfolio initiative that started in 2014 made it possible for each youth to have a portfolio for capturing their youth productions. The practice at the makerspace refined over time and the space iterated across different portfolio platforms for capturing youth productions, inducing the journaling tool Evernote, a drag-and-drop tool called Tackk that has been discontinued at the time of writing this article and finally Wordpress, where youths were encouraged to generate their own menu items to organize their productions online. Apart from the individual portfolio pages, the portfolio system included an umbrella page as a launching site to all individual youth pages. On the landing page, the most recent posts by all youths with a portfolio page at the makerspace were displayed, with 12 posts per page. The portfolio tool at the space also included a back-end interface for curating portfolio posts, including guiding questions to help facilitate the capturing process for youth.

The school makerspace served students in grades 9–12 with career and technical education programs, which focused on vocational skills of the future, including additive manufacturing. The students of the school were predominantly white (64.4%) with 13.0% Latino(a) students and 12.9% black students with 32.4% of the students on a reduced meal program. The school has facilitated portfolio processes since 2014. At the school, students documented assignments and work in progress since 2014. The tool that the school used was Google sites as well as portfolio templates. Yet, the portfolio tool presented opportunities for youth to generate unique online space for curating their productions. Using Google sites did not come without challenges, in relation to accessing older versions of the portfolio tools and managing sharing settings. Thus, the school also permitted teachers the use of open online tools, such as social media sites, for capturing and sharing youth productions.

Participants and case selection

Our engagement with the sites began with two conference calls with educators and site administrators per site that provided an overview of the makerspace portfolio practices and to plan field site visits. Calls typically lasted 1 h, were audio recorded and covered descriptions of portfolios systems and practices, including facilitation strategies and

frequency of created portfolio entries, as well as highlighting particular youths and their portfolios that stood out to educators and why. We summarized the calls and shared the summaries with all participants to ensure that we captured the conversation in ways that aligned with the educators' and administrators' perspectives. The summaries served as planning documents for site visits, as they included suggestions of focal youths who were particularly engaged with capturing making.

To study selected portfolio practices in depth, educators recommended 22 focal youths who were particularly engaged in capturing and sharing their work. Of these, 9 youths were from the out-of-school site and 13 from the school site. The selected portfolios serve to understand how portfolios served (or did not serve) youth in representing their work inside and outside their communities in ways that contributed to these communities and to foster their own creative practices. Furthermore, we conducted semistructured interviews with youth who had created high-profile portfolios, such as those who garnered an exceptional number of views compared to others in the larger sample.

Data sources

The main data sources of this study consisted of the portfolio entries of 22 youths in the school and out-of-school makerspace as well as interviews from among the sample.

Portfolios and portfolio posts

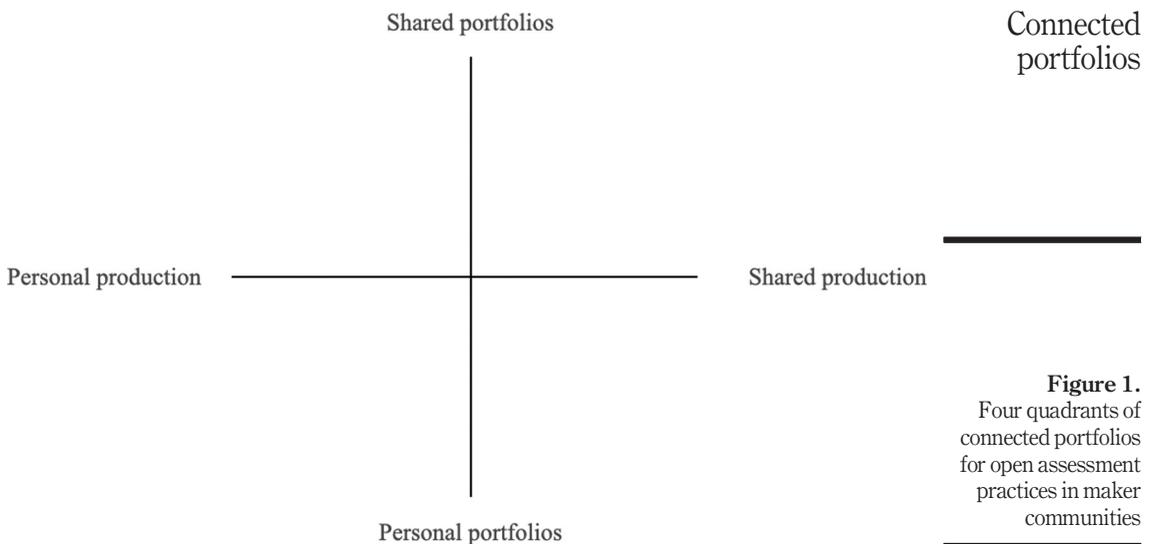
We observed the portfolios of the focal youth over time by regularly opening the online sites, capturing changes over the course of the research by capturing screenshots of all posts, reading the content of all portfolio posts and annotating the posts in an excel spreadsheet. The spreadsheet included information on the location of posts to identify patterns in curation processes (e.g. amount and kind of posts shared on portfolio page vs blog page) and layout changes over time (e.g. changes of background images, menu structures and font types). By the end of our engagement, the portfolios included 569 entries in total.

Semistructured interviews with participants

We asked ten of the focal youths to "walk us through" their portfolios, which fused usability walkthroughs (Rieman *et al.*, 1995) with semistructured interviews (Merriam and Tisdell, 2015). Usability walkthrough is a digital artifact evaluation method, in which a person tests interaction designs of digital media through a self-guided or prescribed scenario (Karat *et al.*, 1992; Nielsen, 1994). Fusing this approach with a semistructured interview meant that we asked youths to think out loud as we requested them to show us their favorite projects, talk about what they learned while creating their projects and elaborate on their reasons for documenting their projects in the way they did. Where applicable, we also asked youths to show us their projects in the makerspace. The portfolio walkthroughs were audio recorded and when youths shared their screens, we video captured their presentation before being transcribed (see [Appendix](#) for semistructured interview protocol).

Analytical approach

Building on the prior research on maker-centered portfolios for assessing making, recognizable categories emerged for understanding youth-centered production and youth digital culture practices that help analyze the utility of portfolio tools for assessment aligned with a connected learning framework (Figure 1). Four categories emerged that helped us to



make sense of the data set. The result of this deductive–inductive approach to analysis included the following four categories:

- (1) personal production paired with personal portfolios;
- (2) shared production paired with personal portfolios;
- (3) personal production paired with shared portfolios; and
- (4) shared production paired with shared portfolios.

Erickson’s (2004) approach to qualitative research guided us to look across entries to characterize the literature inspired themes. To map portfolio posts to the first theme, we defined personal productions as those that were framed as created or framed to be created by an individual youth, for example, the design of an animated character in Scratch (scratch.mit.edu) or the printing of a three-dimensional model of a cup holder. We defined shared productions as those that were framed as created by more than one youth, such as a piece of music or the design of public space furniture. Similarly, the documentation of the personal or shared productions was either captured on personal portfolios (e.g. websites and personal social media profile) or in shared portfolios, for example, an online space that was owned and contributed to by several youths at once, such as a musical band account. To understand how youths used their portfolios to capture personal and shared productions, we sorted all individual posts in relation to the four themes. We then analyzed how the productions and portfolios of selected representative focal youths and their use of capturing contributed to the underlying purposes of their portfolios. Specifically, we sought to understand what the use of the making and capturing types did to generate opportunities for building communities inside and outside the makerspace.

For the purposes of this study, the interviews served to better understand contextual aspects of the portfolio practice that supported the youths in sharing their work within and beyond communities of their immediate learning environments. Thus, we analyzed the

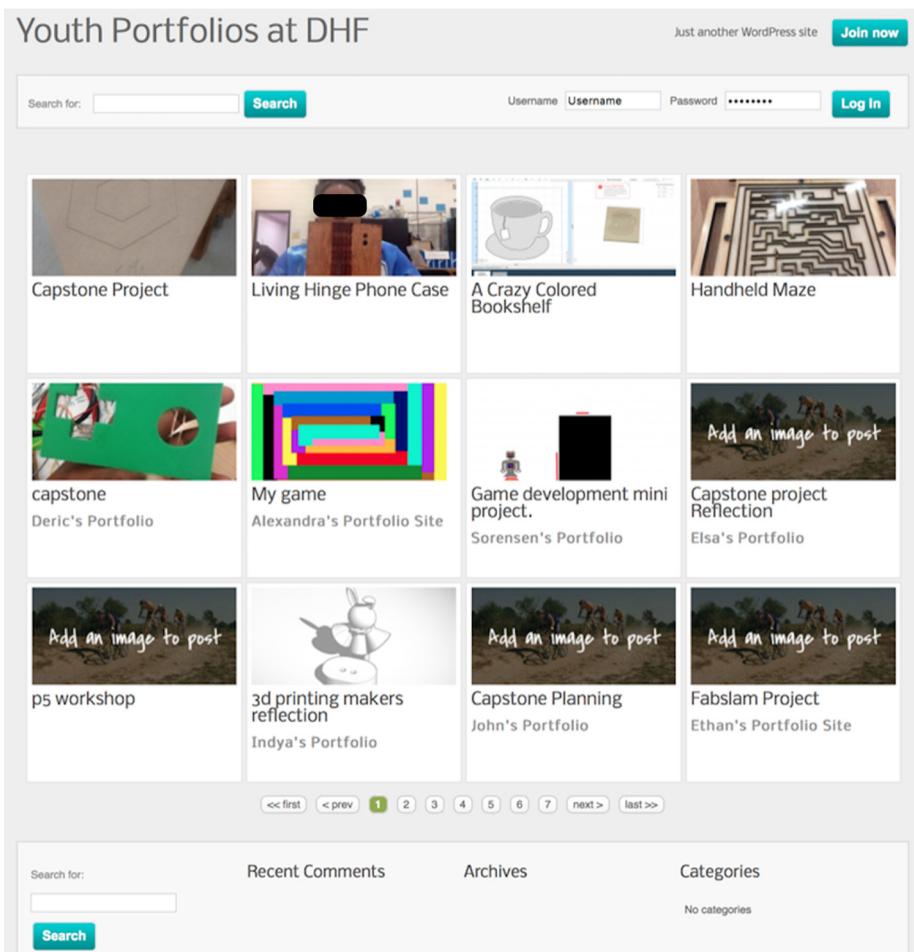


Figure 2. Personal projects that were documented in a shared space

video in relation to the four themes. The interviews also captured youth motivations for documenting and sharing making, which are analyzed elsewhere (Keune *et al.*, 2017; Peppler and Keune, 2019).

Findings

Findings suggest a shift away from assessments that view the individual as the dominant unit of analysis (Lemke *et al.*, 2015) and moves toward a sociocultural understanding of assessment as something to be socially measured in context and, thus, has more value for the learner in terms of understanding and communicating both individual and connected progress and achievement. Connected learning emphasizes this social turn for the nature of assessment and tracking progress, as capturing and sharing personal and shared production over time can be a meaningful measure for an individual’s engagement within a larger community, as well as a measure of the connected nature of the work of an educational site within a network. This type of collectively shared personal assessment

more closely mirrors real-world activity for which one might be assessed, such as taking part in a teamwork and producing a work of art or starting a business – the individual efforts in these cases are only as strong as their relation to the whole of what was achieved. The cases illustrate a range of approaches toward implementing connected portfolios, providing empirical evidence from which we can continue to theorize what it means to make progress and achievement visible from a connected learning perspective. From these cases, we can also start to think about guiding design recommendations for tools and technologies that support the making of connected portfolios. The portfolio cases that we took from ethnographic observations in makerspaces and illustrate representative cases contribute to a move toward collaborative, sociocultural assessment processes that can make visible and that value connected learning as part of youth production and portfolios. We present portfolios that fall within the quadrants of personal and shared productions that are captured within personal and shared portfolios (Table 1).

To be sure, production-centered processes, as well as portfolio processes that capture them, can be personally as well as collectively approached. It is important to consider the possibilities of the range of ways in which production and portfolios can be used to assess maker-centered engagement toward community building and opportunity building. For instance, personal productions that were created by individuals can provide insights into a person’s personal development and their utility of particular domain-specific concepts. Connected productions created by multiple youths can provide insights into connected and collaborative processes within maker-educational settings and shared meaning making in relation to particular domain understanding.

Personal productions shared in personal portfolios within the maker-centered settings that we observed focused on making visible personal projects and techniques that individuals created and used. These types of portfolios present the potential of moving toward connected portfolios. They provide a record over time of the kind of experiences individuals have been part of.

Of the 569 posts reviewed, the majority (81.5%) showed personal productions paired with personal portfolios. This prevalence was expected and is consistent with the default of an individualistic and cognitive paradigm of learning of many traditional applications of portfolio assessments. The posts included projects related to 3D printing, game design and digital image manipulation. When we observed maker activities that were framed as personal productions and captured in personal portfolios, we noticed that youths nevertheless actively crafted together, pointing at or commenting on each other’s projects and techniques, while educators facilitated feedback and peer-review activities. However,

	Personal production	Shared production
Personal portfolios	A record that makes personal productions visible and that <i>could</i> be shared with others.	A record that makes connected productions within local maker-centered communities visible and that <i>could</i> be shared with others. Begins to make connected learning of local settings visible.
Shared portfolios	A record that makes personal productions visible and shows how ideas travel across the collective community within the local maker-centered community. Makes connected learning of local settings visible.	A record that makes connected productions visible within connected portfolios across communities that coconstruct the productions and the portfolios. Lines between productions and portfolios become blurred.

Table 1.
Personal productions and personal portfolios: Making projects and techniques visible

they did not mention any of those shared practices in their personal portfolio posts. Instead, they privileged projects and techniques (i.e. the final products and description of how they made them).

One example is the portfolio of Mingyang who predominantly captured her game design productions. Her long hair tied into a ponytail, we observed Mingyang sit in front of her laptop typing her reflection continuously referring back to the sketches in her paper notebook. As she wrote, Mingyang turned to another youth who sought feedback from Mingyang on their own Scratch game. Mingyang shared her character design and both youths discussed possible integration of their games that could improve both of their productions. Later, we reviewed Mingyang's portfolio, she wrote: "This time I'm updating on this huge game that I've been working on that I'll release on Scratch later on!" Mingyang presented her game design as a project that she did on her own. She did not evidence the rich peer interactions and connections that we observed as leading to ideas for potential of a powerful future merger between two game productions.

Mingyang's portfolio entry is an example of how personal productions that were documented in personal portfolios framed learning as predominantly individual. Portfolios that consisted mainly of these types of posts share commonalities with traditional portfolio assessments with a focus on individual cognitive development and learning progressions. These types of portfolios are a way for makers to keep track of their own making. They highlight the production-centered aspects of connected learning focused on the individual's contribution. Though peer interactions were not part of the final portfolio, the personally meaningful productions suggest possibilities for uncovering how they were interactionally created in the maker-centered space. The personally meaningful entries promised to serve the community as technical explanations that could guide similar projects. At once, these types of portfolios also highlight a possibility for where connected portfolios could go.

While not made visible in the final portfolios, we observed shared productions happening. With a connected learning frame in mind, we can imagine the possibilities that capturing such shared production will have for making connections inside of maker-centered settings visible. For instance, merging media productions is a practice in the media production industry and capturing these engagements can be important learning experiences to build on for individual youth as well as maker-centered learning environments.

Shared productions and personal portfolios: making small group connections visible

Shared productions in personal portfolios made visible the collaborative and connective aspects of youth productions. They explicitly captured the connected learning that we observed in cases like Mingyang's portfolio above and highlighted the potential of portfolios to make visible different aspects of youth productions across several connected portfolios. This type of connected portfolios highlighted communal aspects in maker-centered environments at the site of youth productions.

Of the posts that we analyzed, 12.6% were of this type. They included personal reflections on small-group collaborations, such as descriptions of prototyping new furniture within small groups. The portfolios with entries that referenced social interactions also contained entries on finished projects and techniques similar to Mingyang's portfolio above. Example of a shared production in a personal portfolio was Eliot's portfolio. According to the maker educators whom we collaborated with during the study, when Eliot first joined the makerspace, the 16 years old wanted to learn to feel more comfortable in social situations. Nine months later, during our site visit, Eliot led a team of youths in an online

collaborative game and engaged in prototyping of an architectural structure with a small group of youths. When presenting his work on the prototype in his personal portfolio, he wrote:

Our project was to think of things to fill the unused space [. . .]. We chose the grass next to [the] street to change. The only critique we had was to open up the roof so people could see inside and that was pretty easy we just took it off.

Eliot's post referenced an elaborate peer-engagement process, which included the creation of a project in a small group, receiving peer feedback and integrating it as part of an iterative design cycle. What stands out is that the group members who are referenced in the post seem to all have played the same roles in the project. They all seem to have taken part in all of the aspects of the project. Yet, the potential of shared productions in personal portfolios is also that they present opportunities for presenting a more holistic picture of productions by highlighting multiple aspects that make up the whole project (e.g. sound design and visual design). Within the portfolios we observed the other group members had not referenced the shared production aspects. This speaks to the need to actively facilitate the capturing of shared productions within local settings. Direct facilitation of collaboration through small group projects led to references of social engagement in youth documentation.

The portfolios pointed to the possibility of making youth production-related connections visible across portfolios as an opportunity for assessing connected learning at the site of shared productions within local communities, for instance, showing how connected youth productions happen, comparing how different youth productions catalyze production-centered connections and how small group facilitation can make visible collaborative and connected accomplishments. Furthermore, these kinds of portfolios move us toward a vision for connected portfolios. Connected portfolios promise to show an individual's achievement in relation to projects and techniques (on the individual cognitive side). When youth augmented the documentation of shared productions with evidence of social interactions during making, the portfolio showed teamwork processes. Thus, over time, the portfolios promise to present development of team skills, teamwork engagement and potential shifts in a youth's role in their local community and their reflections on their roles as contributing group members (on the sociocultural and connected learning side). These types of connected portfolios point to the possibilities of what connected portfolios within maker-centered environments might be able to make visible in terms of connected learning accomplishments and contributing to community building inside the makerspace.

Personal productions and shared portfolios: making connected learning in local communities visible

Personal productions that were shared in shared portfolios presented a unique aspect of connected portfolio that curated individual portfolio entries of youth within a local maker-centered setting on one page. This type of portfolio linked to individual portfolios that included personal as well as shared productions. Making such connections visible at the makerspace at large presents an opportunity to make visible ongoing and deepening connections, which can serve to level up programming toward understanding aspects of programs that make connections especially possible and productive. Such portfolios further present an opportunity to compare projects across youth members and to highlight youth production trends within the maker-centered learning environment.

An example of personal productions captured in shared portfolios is the out-of-school makerspace we collaborated with that curated all individual youths' portfolio entries on one website and highlighted the latest entries by each youth on one page (Figure 1). At any point

in time, when a youth uploaded a new post, their post would be moved to the front of the shared portfolio, displaying any image that accompanied the personal production. Clicking on the image led to the full post from where the entire youth portfolio was accessible. On the bottom of the shared page, small buttons with page numbers linked to all of the latest portfolio entries at the makerspace. All content on the shared page was generated automatically and the page did not highlight youth names or number of posts per youth. Youth mentioned that the shared page was “pretty nice, because you can look through and see what other people have done and get a lot of inspiration.” Youths seemed to consider the possibility to see the work of other youths as a way to inform their own projects.

The shared portfolio of several personal projects provided a sense of the current makerspace youth productions, how they integrated and how individual youth specifically engaged with them. This type of connected portfolio was like a barometer of what was happening at present. Seeing the accumulated work served as a springboard for new youth productions, whether personal or shared. Youth could see what others were doing, get inspired to enroll for courses, see who else was engaged in similar work and whom to ask for advice. From an individual and cognitive perspective, the shared portfolios that shared personal productions could be viewed as a way to compare and contrast youth also against a baseline of ongoing activities at the makerspace (e.g. how well one individuals' project compared to others or how unique an individual project was in relation to the kind of activities that were facilitated in the makerspace). However, from a connected learning perspective that takes sociocultural and community building aspects as important aspects of making visible youth accomplishments, this kind of portfolio made visible insights into the collective potential of the makerspace community and the types of productions that individuals have access to as result of their makerspace membership. The portfolio type makes visible how ideas travel across people in the same maker community and points to promises for how portfolios make visible connections among different communities and to people beyond the local maker community.

Shared productions and shared portfolios: making community building visible

Shared productions in shared portfolios made processes for community building visible. Though all portfolios in all quadrants were examples of moving toward connected portfolios, the portfolios that we categorized in the fourth quadrant included more aspects that we would expect to see in a connected portfolio compared to the portfolios in the other quadrants.

This type of portfolio stretched across platforms and invited audience interactions inside and outside the makerspace into the youth production and youth capturing process. Community members became coconstructors of productions and portfolios as these portfolios made it possible to respond to followers and their wishes by producing content toward particular interests and toward further increasing community building aspects. These portfolios present evidence of a move toward sociocultural and networked assessments that are aligned with connected learning and the ideas of making visible progress across settings.

One of the portfolios we viewed included such portfolio entries and this portfolio serves as an exceptional case to learn from. Involved with media production courses, Ted had been capturing motion pictures on YouTube (Figure 3, top) since he was 13 years. The videos include music videos, digital logo animations and special effects that spanned commissions by local businesses, personal explorations and school projects. At first glance it was a personal portfolio of personal productions. Yet, Ted linked his channel to collaborators and

Connected portfolios

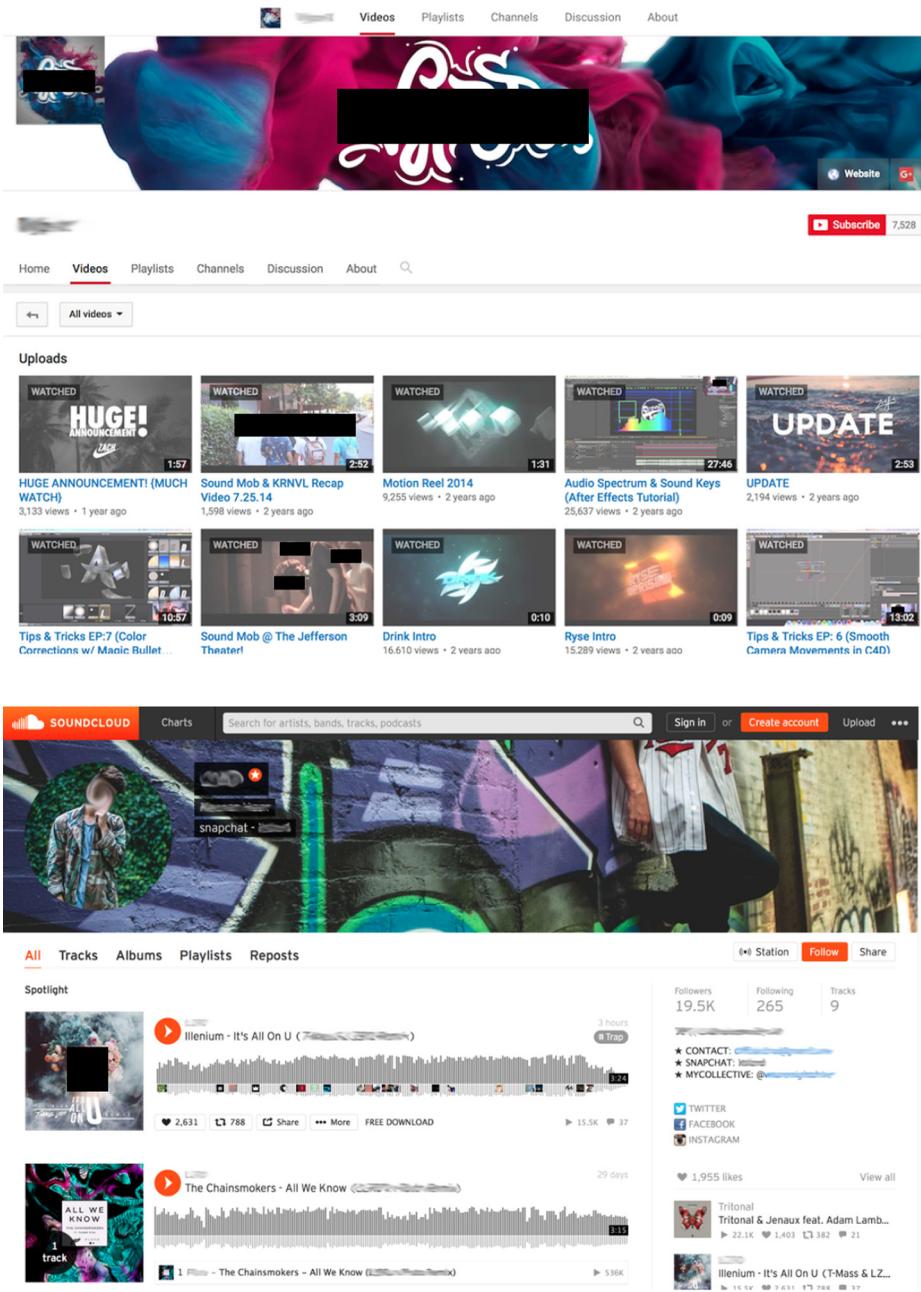


Figure 3. Ted's personal YouTube channel (top) and Ted's shared Soundcloud account (bottom)

actively called for reviews, which encouraged the building of a community around his work and produced a connected portfolio that stretched across several youth portfolios.

Also the youth productions that were visible in the shared portfolio were shared productions. For instance, the channel had over 7,000 subscribers and each video had between 2,000 and 18,000 views. The videos also attracted technical questions or suggestions by viewers:

Viewer: Where did you find the footage of the clouds. I've been searching it for a long time.

Ted: I actually forget! Just search free stock footage online, and then search for clouds or sky, I'm sure you'll be able to find it, if not something else.

Ted responded to each of the comments he received in a similarly constructive way, making it possible to invite others into the production process. What is more, Ted shared tutorials of special effects through Speed art videos, which are time lapse screen captures that record his process. The process transparently captured him jumping between video animation and video chat tools. This showed the connected aspects of the productions he shared online. He highlighted video chat as an “instantaneous way of talking to people [. . .] and showing them my work.” On the video chat application, Ted connected to youths who were similarly interested in digital animation and whom he met on YouTube as part of his video community. Ted valued their feedback and actively sought it out as a form of assessment that immediately benefited his project.

Another example of shared production and portfolio practices was Ted's Soundcloud account, which he co-owned with a high school friend (Figure 3, button). They recorded, produced and published audio remixes from a parent's basement. The account has over 19,000 followers.

When applying to college, Ted curated his work on a website that had expired when we spoke to him. He mentioned: “For now, I've already gotten into college. [. . .] My portfolio is almost word-of-mouth at this point so people can show other people the things that I've done.” Ted was not concerned about the “sketchbook” character of his portfolio, which lacked a unified narrative. The distributed and networked nature of his connected portfolio included shared projects and were documented in collective and shared ways, which allowed him to establish himself as an accomplished maker who engaged people across communities.

Ted's portfolio questions the process of building a portfolio as a unified narrative and shows that a connected and networked portfolio across social media tools and across accounts can be useful for making connections across settings, for making accomplishments and progress visible to different communities and for furthering youth productions in connected ways. Ted's distributed body of productions supported him in building a strong digital online presence and communities within the local maker-educational setting (e.g. when collaborating with others on Soundcloud) as well as beyond (e.g. when connecting to youth with expertise and willingness to assess his work via video chat, tutorials and peer assessment). From an individual and cognitive perspective, the expiration of his curated portfolio website with narrative representations of his overall body of work would have been considered most valuable and the expiration of the same a missed opportunity for capturing and assessing his accomplishments. Yet, from a sociocultural and connected learning perspective, it was particularly the shared nature of his portfolio that made visible shared projects that offered Ted an opportunity to engage in meaningful ways with a community, contribute to community and learn with it. It highlighted Ted as a member of

society and facilitated his trying on different roles as he engaged with online communities, called for feedback, responded to it and credited others.

Discussion and implications

This study of connected portfolios has implications for considering assessment from a connected learning perspective, moving from traditional portfolios as a measure of individual cognitive progress and toward a sociocultural and networked process documented over time. The cases presented here, in particular Ted's digital portfolio, which highlighted shared productions and portfolio sharing, call to consider how a digital portfolio can have greater value for a learner in terms of understanding both an individual contribution as well as the shared production process to document what was achieved. Furthermore, the push to publicly share a digital portfolio such as those presented here emphasizes individual and collaborative production practices and serves to build community networks around the work as it is launched into and vetted by targeted audiences and communities of practice.

As a set, the cases presented here have implications for further theorizing how connected learning environments can support making progress and achievement visible across settings through digital portfolios that highlight the socially shared nature of artifact creation. Through analysis presented here, we argue that connected portfolios, that is, digital portfolios aligned with a connected learning framework, ought to:

- have immediate personal meaning to the learner as that learner interacts with and shared with a community (e.g. through sharing a portfolio on a digitally mediated platform to gauge targeted audiences' reaction); and
- be authentic to the social nature of artifact creation (e.g. describing the connected processes that led to an artifact featured within a digital portfolio).

Keeping the facets of this argument in mind, in the remainder of the paper, we highlight the value of each case in terms of the type of connected learning portfolio processes it illuminates as well as how as a collective the cases further our theorizations of making progress and achievement visible across settings as part of a connected learning-focused assessment process. First and foremost, connected portfolios acknowledge that it is not only about the tools that are used for capturing and sharing creative project but more so about the possibilities the portfolios provide to generate a powerful collective, networked and openly growing community of people who are passionate about similar things. The work presented in this article promises to guide the design of tools that can support the production of connected portfolios (see [Figure 1](#)).

Collectively, the cases we present further our understanding of making progress and achievement visible across settings as part of a connected learning-focused assessment process. Aligned with our connected learning perspective, the findings have implications for the design of digital portfolio processes and assessments that capture the connected and social nature of creative work. They point to the importance of facilitating collaboration in youth project production and portfolio capturing and encouraging editable portfolios rather than unified narratives. However, the fact that portfolios did not often show shared production does not mean youth did not share. Through shared productions and shared portfolios, the youths' roles inside and outside of the makerspace can be encouraged and made visible, broadening portfolio assessment beyond capturing knowledge and skills and toward making progress and achievement visible across settings in terms of the quality and connected nature of contributions. This pushes our understanding of the role of portfolios as tools for assessment toward evidence of the roles that youth can take on within

local communities and beyond. Overall, the findings point to the importance of considering the sociocultural nature of making and capturing making when designing portfolio assessments that are intended to serve as community building tools inside and outside of makerspaces. That is, these connected portfolios reject traditional portfolio formats that privilege the individual and cognitive measures of performance. This work advances connected portfolios as it highlights the importance of the use of a range of online tools that provide access to people outside of the makerspace to view, comment on and assess the youth's projects in ways that supports them to act as responsible members of society who meaningfully interact with and contribute to communities beyond their local and immediate learning setting. By sharing in a community, an investment in the spreading of understanding, insights, projects and processes is evoked. Through creative productions that are supported by connected portfolios, unexpected new opportunities, such as learning about a new set of skills or receiving a job offer, may arise from these acts of community building.

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Appendix. Semistructured interview protocol

Topic 1: making and documenting

Lead-off question: Could you tell me a little bit about yourself?

Back-up question: What is your name?

Follow-up questions:

- What did you make?
- Can you show me your 1-3 best pieces of your portfolio?
- What do you like about them?
- Why do you make it?
- How did you make it?
- Where did you make it?
- How did you learn?

Topic 2: motivations

Lead-off question: Now tell me about why you make the portfolio.

Back-up question: What are the reasons for creating this portfolio?

Follow-up questions:

- (1) Who have you shared your portfolio with?
- (2) Has anything changed now that you have a portfolio?
 - Has your portfolio led you to meet new people or find new opportunities?
 - Have you met someone new?
 - Have you got a job through the portfolio?
- (3) *Some youth* say that documentation takes away from making. How would you respond to them?
- (4) *Some people might say that grades are everything one needs to know about a learner. What do you think?*

Topic 3: assessment

Lead-off question: Who have you shared your portfolio with?

Back-up question: Has anyone ever looked at your portfolio?

Follow-up questions: Why did you share it with them?

- Do you have any plans with your portfolio?
- Pick an audience: your mum, your friend, Apple, Microsoft, Nike, MIT. How would you tell your making or learning to them? What would they find compelling? What would you want them to see?
- Some people say “share early and often.” *What is your opinion on that?*

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