

Connecting learning – parents and young children in museum makerspaces¹

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Introduction

On a crowded Saturday at the Bay Area Discovery Museum (BADM), children from toddlers to ten-year-olds ran in and out of buildings, blowing bubbles and making gigantic constructions from foam building blocks or using unusual objects to make music. Within the former military barracks tucked into the fog below the northern end of the San Francisco Golden Gate Bridge, the facilitators have built on learning research to create spaces for “STEM-focused, inquiry-driven experiences that help children develop creativity and creative problem-solving skills”².

At the edge of the courtyard was what the facilitators called the “world’s first early childhood FabLab”.³ Founded in conjunction with the Fab Foundation, it had equipment similar to that of adult makerspaces – 3D printers, a laser cutter and a CNC router, a table piled with tablets – along with bins of markers and child scissors, stacks of cardboard and multi-coloured tape, plasticine, hammers and nails.⁴ Crowded around the low hexagonal tables were rotating crowds of children, sitting by themselves or on their parents’ laps. Although the entry sign advertised that today’s activity – designing and making an aerodynamic flying machine using the tablets and laser cutter – was for children aged five and above, the room also bustled with toddlers and older siblings.

Children’s making activities in museums are generally facilitated by adult intermediaries – the accompanying parent or caregiver as well as the facilitators.⁵ Parents enable the making by identifying the opportunity and finding the resources (cost of entry, transportation). In some cases, they also get involved in helping children learn, though others are hopeful but unsure of their role. Indeed, their role may remain unclear, even as their child is welcomed into the makerspace and quickly occupied with tasks. Should a parent sit with their child or hang back? How ‘helpful’ should they be? What is expected of them by the facilitators, or indeed by other onlooking parents?⁶

Drawing on ethnographic research conducted in 2017–2018 in three museum makerspaces in the San Francisco Bay Area (California, USA), this chapter focuses on the role of families, usually parents but sometimes grandparents or other relatives, in facilitating young children’s activities in museum makerspaces. Our enquiry is situated in the ‘connected learning’ framework, which explores the benefits for young people of informal and non-formal learning across sites, especially in the context of new digital opportunities to “hang out, mess around and geek out” (Ito et al., 2010). Connected Learning proposes that digital media provide unique opportunities for children and young people to follow their passions and interests across the multiple

(traditionally siloed) spaces of their lives – home, school, peers and interest-driven learning spaces (Ito et al., 2013; Livingstone and Sefton-Green, 2016).

When we joined the MakeEY project we noted some of the same observations we had made in our previous project, *Parenting for a Digital Future* (P4DF, Livingstone and Blum-Ross, forthcoming), in which we had studied families and technology use including observations of children in digital media and learning sites. We saw how in initiatives to facilitate digital media learning, parents are often left hesitant on the sidelines – neither positively invited to join in nor really able to leave. Whether hanging around in corridors outside classrooms or on the edge of a busy room of child-focused activity, parents are often at a loss, not introduced to each other and so unable to chat, instead filling the time by staring at their phones. We wondered, like them, what the facilitators expect of them. We also we wanted to know, what do the parents expect – of their child, the facilitators, themselves? What led them to bring their child here, and what might they do differently when they return home? As in the graphic design or music technology classes we had previously observed during P4DF, we noted some of the same hesitancy. However, in the case of making, here, with younger children involved and with a more direct invitation to parents from facilitators (as we discuss below), we noted the capacity for more active engagement. In this chapter we argue that parents can play a role in connecting or disconnecting learning across people and sites, especially when children are young. We explore how this role is conceived and whether it could be better designed.

There is very little research on parents and making (Marsh et al 2017 although see Roque, 2016) and little more on families and museums (Ellenbogen, 2003; Nadelson, 2013). Parents value the promised ‘educational’ benefits, although families differ in their interests depending on multiple factors. Insofar as families arrive at the museum as a unit (however composed), they act as “dispersed learning systems”, and so are unlike individual visitors in the sense that they move through the museum together and apart, reinforcing one another’s experiences (Brahms and Crowley, 2016, Benjamin, Haden and Wilkerson, 2010).

In this chapter, we first consider how the institutional and physical arrangements of museums and the relationships with museum facilitators ‘invite’ (or not) parents to participate alongside children in making activities. Second, we map the range of ways in which parents enact more or less supportive roles during children’s making experiences. Our findings are based on observations made and interviews conducted with facilitators, parents and children during visits to three museums in Silicon Valley in 2017 and 2018 – the Bay Area Discovery Museum (BADM), The Tech Museum of Innovation (‘The Tech’) and the Lawrence Hall of Science (LHS), each described below. We visited each museum three to five times, for several hours per visit. We began with ‘gatekeeper’ interviews with senior museum staff, then scoping follow-up visits to capture the range of activities and participants (for instance, by arranging some visits on no-cost or outreach days). In each location, the museum facilitators placed a sign at the

makerspace entrance notifying parents of our research and informing them of their option to decline participation – by telling us or the facilitators. We conducted interviews with families opportunistically, giving parents an information sheet, asking for permission to audio- or video-record activities, and for signed consent for interviews. Some parents were happy to speak with us but declined to be recorded. The interviews, photos and video recordings were hand-coded inductively according to emergent themes, albeit in ways framed by relevant research (as cited in this chapter).

Museum makerspaces

Museum makerspaces present opportunities and challenges within the aim of involving parents with young children in the process of making. All the museum makerspaces we visited prioritised easy-to-achieve activities that could be completed in a quick visit, although some families stayed for longer periods of time (Sheridan et al., 2014). But museums are often crowded, and filled with other things to see and do. Parents may discourage children from staying too long in one place.

The three museums had different characteristics and aims. Although some of the activities were similar (this was unplanned, although the activities are also reminiscent of other projects described in this volume – there being an emerging canon of age-appropriate making activities for young children), these were adapted to their particular environment or emphasis. In each, we saw such mechanical engineering challenges as creating an aeroplane or designing a vehicle to carry a ‘payload’. Differences among the museums are neatly illustrated by their gift shops: at The Tech the shop was filled with T-shirts and mugs emblazoned with the word ‘Geek’; at LHS they sold science-oriented gifts (geodes, a periodic table); at BADM they sold fairy costumes and craft kits.

The Tech is located in San José, a mixed ethnicity city at the Southern end of Silicon Valley. Just a few miles from where Steve Jobs founded Apple computers, it was the most technology focused, with permanent exhibits on microprocessors, cybersecurity, robotics, VR and more, sponsored by such companies as Intel, Google and Lockheed Martin. Its makerspace - the **Design Lab** – occupied a substantial area on the lower floor cordoned off with barricades. This required parents to enter through a designated opening staffed by a *greeter*, a technique also employed by the other museums. The Tech’s exhibits were fairly conceptual, perhaps explaining why the families we interviewed here had children at the older end of our age range (6+). Facilitators described their ‘sweet spot’ as eight-to-nine-year-olds, although in practice there

were many older and younger children. Unsurprisingly, given its location, many families we spoke with worked in technology or related companies.

The LHS is across the bay from San Francisco in Berkeley, California, and affiliated with the University of California, Berkeley, university home to the world-renowned physics laboratory where the ‘cyclotron’ (a particle accelerator) was invented; the museum is built in brutalist concrete to resemble the cyclotron. Many of the younger facilitators and volunteers at LHS are drawn from UC Berkeley. The target age for visitors was a bit younger – children aged four or five years, although again there was a range. LHS’s dedicated makerspace – the **Ingenuity Lab** – was in a dedicated downstairs classroom. Some of the parents we spoke with ‘worked in tech’, but the range of experiences was wider, including university parents also.

The Bay Area Discovery Museum (BADM) is located in Marin, at the northern end of San Francisco Bay, at the end of a long winding road that leads onto historic parkland where the museum is housed in former army barracks. Of the three museums, BADM has the most visible emphasis on ‘creativity’, in addition to science. Rather than emphasising ‘engineering’, as at The Tech or LHS, BADM facilitators talked more of ‘design’ or ‘imagination’, describing it not as a “children’s museum or a science museum but an early childhood centre with a science focus”. However, its makerspace was by far the most digital of the three museums – with activities including designing prototypes on paper, then on tablets using the design software Tinkercad, then cutting out shapes and assembling before testing and iterating designs.⁷ Visitors were a mix of local parents from a range of professions, including tech; being located near the Golden Gate Bridge and within a national park, BADM also attracted many tourists.

We were not able to collect demographic data on the museum visitors, instead inferring some socio-economic circumstances from our observations or from information gleaned in interviews. Many parents were high in economic and cultural capital, for instance working in software engineering or academia, and most were White or Asian. That said, the museums were sensitive to diversity, attempting to attract new visitors through targeted outreach.⁸ At BADM a senior staff member told us,

“We do have an over-representation of ... college-educated, wealthy, affluent, privileged families. Our school groups definitely are one way that diversify the audience of kids that we are bringing in, and we are spending a lot of time thinking about how, how to diversify further, given the immediate communities are very affluent.”

BADM had created a mobile makerspace they called the Try it Truck, to bring making activities – including some specialist digital equipment – into surrounding low-income communities. The truck had taken considerable resources to build, although the senior staff told us that it was “very donation friendly; family and corporate donations have been pouring in and it’s actually fully

funded for the next 2–3 years which is awesome”. The Tech ran similar outreach with local schools and held a quarterly ‘sensory day’ for young visitors on the autism spectrum.

Are these inviting spaces for parents? In all three museums, ‘greeters’ subtly telegraphed to parents their responsibilities – for example, giving them instructions to get their child started and, thereby, reinforcing the idea that the activity was not a ‘drop off’ session where parents could leave children unattended. In each museum, although especially at BADM, the makerspace was scattered with table-top signs and posters giving prompts to parents about the activity – some were heavily text-based giving explicit ‘tips to support your child’ or explaining the activity. However, we rarely saw parents glance at these signs, preferring to turn to museum facilitators with questions instead.

In other respects, each makerspace was different in how it invited (or didn’t invite) parents into the activities designed for their child. At BADM the tables and chairs were very low (as in primary schools) or activities took place on cushioned mats on the floor. Parents had to physically crouch, lean over awkwardly or sit on the ground if they were to join their children. Although many did so willingly, or crowded in with children on their laps, the material arrangements were more comfortable for children than adults. At The Tech, tables were at waist height (on an adult) and there were no chairs at all. The facilitators explained this was designed to help parents get involved (since when they had chairs previously, parents tended to sit to one side). At LHS the makerspace resembled a classroom for older children, with tables at a more comfortable height for adults; here the parents spent the most time sitting next to their child(ren) – this space was most comfortable for those with limited mobility, and here we saw the most active grandparents. Far from casual, these material arrangements occupied a lot of facilitator effort. A senior staff member at The Tech described how they worked to

“support whole family groups ... One of the points of friction can potentially be the fact that we have these longer dwell time activities [such as making] now. So, you know, if an older sibling who is eight or nine or ten really wants to do one of our activities, there’s got to be something for the rest of the family like a nearby exhibit or naptime space. We are trying to think about the family experience holistically, not just focusing on the eight-year-old.”

How facilitators view parents

Planning for whole families is demanding in terms of resources, and because facilitators generally know little of parents’ skills, concerns or circumstances. In makerspaces for young children, relating to parents cannot be avoided. In our interviews with facilitators, although they strove to be positive we found them sometimes critical of parents, since their efforts were most needed in the face of problematic parental behaviour. Our questioning drew out how their

observations of parents' interactions with children led them to alter their own practice or reconfigure the makerspace. For example, they worried about the 'problem' of parents who were either uninvolved in their children's activities or so involved that they 'took over' what their child was doing. A librarian in the space visited by the Try it Truck explained to us that she

“sees a lot of different parenting styles ... sometimes there are parents who are very encouraging. Sometimes I do get some parents who are literally on their phone the entire time and not paying attention to what their child is doing. There's everything from being really engaged, sometimes actually doing the activities for them, to being more of a supportive role and encouraging them to do it on their own. It's a mixture of all of those things, sometimes with the same parent.”

While parenting styles indeed vary, for any activity, makerspaces face the particular pedagogic challenge that their very ethos is one of open-ended tinkering, iterating and learning from mistakes. A young BADM facilitator suggested that parents were tempted to take an overly “hands on approach” because

“I think that the protective parents don't want their kids to fail. But that's part of what this space is – a safe place to fail; the design process *is* failing, and testing and improving.”

To persuade parents to leave behind their focus on outcomes and recognise the distinctive learning process of the makerspace, the BADM facilitators had created signs which read: “Think, Make, Try.” Faced with sometimes “pushy” parents who seemingly could not let their child do the activity by themselves, stepping in when failure was threatened, one facilitator described how parents often “underestimate what kids are capable of doing”.

Recognising that parents have “so many different mind sets”, a Tech facilitator explained how she tried to avoid a “one size fits all” approach, trying

“to keep parents involved, whether it's having them play a supportive role like holding pieces together or having parents be a documentarian, taking photos and really celebrating the different parts of the process.”

One BADM facilitator went so far as to suggest that parents are their ‘true impact audience’, the makerspace's aim being

“about changing the behaviour of adults. Because we have a kid here for 45 minutes, that doesn't change their life. But if in their parents coming here or their teachers coming here they see something differently, they think about how to, to set up learning

experiences for their kids differently ... [this makes] parents much more meta-aware of what kids can do.”

Thus, facilitators talked of “modelling” to parents the brokering and scaffolding activities needed to facilitate children’s learning. For example, a BADM facilitator described how she would try to “spoon-feed more open-ended questioning” to parents, showing them how to elicit questions in turn from their child (rather than just asking the child the kinds of yes/no questions which turn the interaction into a test of knowledge). This dual goal – of educating parents through educating their children – remained unstated in a museum context where formal evaluation emphasised attendance figures and customer satisfaction as much as learning outcomes. Facilitators were uncomfortably aware that parents might not take kindly to being instructed, as a young undergraduate working as a facilitator at LHS explained,

“whenever I’m talking I make sure to make eye contact with the parent and the child. I make sure they’re all included in the conversation of what we’re doing, getting them both excited ... for the most part it’s not a problem. But when a parent is not really involved or just sitting with the kid, I always try to go and try to build with the kid and then find little ways for the parent to pay attention ... like saying ‘do you want to show your mom?’ ... I’m still navigating that, to be honest, because I don’t want to be necessarily rude and be like, ‘Hey, you should look at what your child’s doing.’”

The view of parents, by facilitators, was thus ambivalent – both acknowledging the strengths of some by aiming to shape the actions of others. How, then, did we see this play out in practice?

Parent roles in makerspaces

Building on research on how parents, of diverse backgrounds, support children’s digital interests and the development of digital literacy (Barron, Martin, Takeuchi and Fithian, 2009; Barron and Levinson 2018; Brough et al., forthcoming) and how parents act to support children’s emergent interest in STEM-related subjects, even when they lack subject-area knowledge themselves (McClure et al., 2017; Brahams and Crowley, 2016), we developed a typology of different ways in which parents interacted with children within makerspaces. Before detailing this typology, we should note that these categories are not static, and many parents moved between and amongst different roles even within the same visit. Compared with the facilitators, our advantage as ‘outsider researchers’ was that we could interview these diverse parents about their perceptions and choices, asking parents about their expectations of the makerspace and how they conceived of its relation to their child’s learning at home or school,⁹ bringing a rarely-heard parent perspective into research on children’s digital media learning.¹⁰ This typology is a set of composite actions, bringing together observations we made across different sites.

Babysitting

Although facilitators realised that parents may “need a break” when they come into the makerspace, accepting that they may not always take part, they were disparaging of parents they saw as disengaged. For some parents, basic supervision seemed sufficient for their role in makerspaces. But is there more to it? At BADM we observed an Asian-American mother enter with three sons aged six to ten to do the cardboard sculptures activity. As the boys gathered materials on the floor, she found a low chair to the side of the room and checked her phone while the boys began enthusiastically hacking at the thick cardboard with the available tools. Our fieldnotes recorded:

She sits nearby, takes lots of pictures on her phone ... periodically shouts out ‘careful!’ or ‘watch your hands!’ but doesn’t really give any other guidance. Oldest kid in particular is enthusiastically singing, designing with pencil and then cutting with a saw.

In conversation with the mother, she described her careful attention to her children’s diet and activities and her overall concern for their “health and safety”. We learned, too, that she thought coming to the makerspace was the ‘right’ thing to do, but she lacked a language for what they were doing there. This was not necessarily a matter of social class, for museum entry and her phone were costly, and she told us not only of other museum visits but also that she only buys organic food. So perhaps puzzlement about making and makerspaces helps explain some parents’ adoption of a ‘babysitting’ role across the economic spectrum.

In the Try it Truck in the low-income community (parked outside a public library), we saw another mother, a Filipina elder care worker, who had brought her daughters aged six and eight to the after-school activity because they were regulars at the library and found it ‘relaxing’. On this occasion, after helping the girls get set up with one of the activities, she spent the session outside on the library computers, checking in periodically. The two girls helped each other through the different activity stations, requiring minimal supervision. Although the librarian we interviewed expressed some frustration at parents who simply dropped off their children and didn’t engage in the activity, she was sensitive to the fact that within the low-income community “a lot of parents are really overworked, they’re working multiple jobs. A lot of times they are really dependent upon our resources.”

At the end of the session we interviewed the family together. The older girl described her yearning for Minecraft, which her parents did not want to pay for, saying “my dad said he doesn't like to buy stuff on the app store. He said why would you pay for it when you can get a free one? But the free ones, but they're not even one bit like Minecraft.” The mother had begrudgingly agreed to the purchase of Minecraft for the daughter’s upcoming 9th birthday because, she said,

“it's creativity and, you know, maths.” At the makerspace, the girls were using tablets loaded with Tinkercad, which their mother considered good because it was “hands on”, in contrast with their use of tablets at home, when she would lose track of time while “busy, cooking, so we forget what time it is already, like two hours of playing and then I feel disappointed when it's too long for them ... it's going to break their eyes.” Thus, while minimally ‘babysitting’ her children within the space, the mother had brought them because she believed in its benefits, in contrast to her worries about ‘screen time’ at home (Blum-Ross and Livingstone, 2018). Seemingly, in neither space did she conceive of an active or engaged role for herself in supporting or connecting her daughters’ learning. As we know from wider public discourses, insofar as parents adopt a babysitting role, whether at home or in museums or elsewhere, they are tacitly judged.

Supervising

Some parents engaged in what initially seemed to be ‘babysitting’ but instead turned out to be a subtle form of supervision. Far from disengaged, we discovered in our conversations with their parents that they were practising a highly engaged but ‘hands off’ form of encouragement. For example, at The Tech Museum, we met an African-American mother who was standing nearby but several feet back from the high table where her daughters (aged eight and ten) were taking part in the ‘from here to there’ activity, where they had to deliver a ‘payload’ across a model of the San Francisco Bay. Though not asking questions or offering advice, nor was she looking at her phone or doing anything else, saying when asked “I just want to let them do it themselves.” When the girls took their contraptions over to the map she moved with them, staying nearby, asking a couple of questions like “is it too heavy?” but not touching the materials herself. Her daughters stayed an unusually long time within the activity, testing out their designs over and over again, changing and tweaking their configurations to make the rubber bands tauter or change the angles on the beam. Their mother stood quietly but steadfastly nearby – only very occasionally asking or prompting by helping (especially the younger daughter) solve a problem.

Supervising independent learning in this way was not entirely unusual. At LHS we interviewed a White mother of a six-year-old boy, attending for his birthday, who similarly stood back from a child’s activity. She too had an articulated philosophy as to her seeming disengagement:

“If I’m with him, he will want me to help him. So I often try and just leave him alone. I want him to feel challenged when his mind doesn’t know how to do something, or when he thinks he might not be able to do something. If I’m not there, and he is forced to figure it out, then that’s where the magic happens, and that’s where growing happens.”

Thus, what may look like disengaged parenting may in fact be a highly conscious effort to give children space to let their ideas evolve themselves.

Cheerleading

Both babysitting and supervising were often combined with *cheerleading* – in which parents praised and celebrated their child’s accomplishments, often loudly, often too by taking photos or video. Indeed, it seemed to us that the advent of the smartphone exacerbated the normative expectation that parents would join in with cheerleading, the ritual of recording children’s activities seemingly hard to resist, and with some children often watched most closely through the phone’s camera lens. Cheerleading may also have been common because it did not require parents to have any specialist knowledge or understanding of the activity itself – and as we saw in the instances above, parents did not always grasp the nature or purpose of the activity, and they could be intimidated by the presence of 3D printers and laser cutters, as well as the young and confident facilitators. It offered a familiar form of parental engagement for those inclined to sit out the session on their phone, or who were preoccupied with accompanying babies or toddlers, looking up when their child returned from an activity to regale them with their success.

As already discussed, cheerleading tends to transform what’s meant to be learning-by-doing into learning-as-outcome – as when parents waited for the end of the activity to take a photo, hoping for a completed product (however rough and ready) to be held up proudly. Relatedly, cheerleading favours successful outcomes over learning by iterating through trial and error, for all that a facilitator may explain that learning by reflecting on why things went wrong can be far better than the lucky fluke of early success. For example, in our fieldnotes we recorded myriad times in which parents made supportive but relatively banal statements like “that looks great!” or “good job!” This is not to say that there is not a place for these enthusiastic responses, for children were often quite evidently pleased to have made their parents happy, but such statements were rarely tailored to the task at hand or helpful in helping a child understand the strengths or weaknesses of the approach they had taken.

Problematic from the connected learning perspective, cheerleading individualises the activity; a facilitator may have mobilised children to collaborate as a group, but over and over again we saw parents take a photo of their own child at the end – possibly being nervous to photograph other people’s children, possibly not recognising the collective nature of the activity. Indeed, the very moment of celebration easily dominates a ‘teachable moment’, often shared with a group, when at the end of an activity, had parents not gathered so excitedly with their congratulations and flashing phones, facilitators might have drawn out of the children some reflections on what worked, or not, why and what do try next.

Collaborating

Some parents took a more hands-on approach to scaffolding their child’s learning in the makerspace, e.g. by physically assisting in the creation of a designed artefact or collaborating on

envisioning what the child might complete. At BADM we met a mother who was attending with four children aged six to nine, two of her own and two of her neighbours'. The mother, an immigrant from Armenia, worked part-time in science policy with a husband who was a software engineer. Amidst a creative cardboard box activity, she sat on the floor to work with the two youngest children, while also cheerleading for the older ones.

Unlike many of the parents we observed during this activity, she started the children off by looking at the sample pictures provided by the facilitators to illustrate the different constructions they might make. First, they brainstormed together, and then she encouraged the children to create 'shelters' for their stuffed animals. The mother alternated between different postures – prepping materials for the children to add to their creations (e.g. ripping off pieces of tape for the child to stick on) and providing feedback and encouragement. She was clearly resisting 'taking over' the task, as our fieldnotes recorded:

The son is trying to get a piece of cardboard onto the base of his pyramid shape – mum says 'It's not big enough, honey, get a pencil and measure it.' He goes and gets a pencil and a bigger piece of cardboard – she shows him how to hold the shape onto the base and draw around but hands the pencil back to him after making the first mark. Then he gets the small saw, starts cutting the cardboard while holding it in the air. She says, 'that's a dangerous way to do it, here let me help you' – braces the piece on the floor and scores a cut about an inch deep at the top to hold the knife in place and then hands it back so that he cuts it himself.

While the mother engaged in cheerleading (saying "awesome! It's perfect") her feedback was more concrete and specific – for example telling one child, "I really like the pattern you made with the tape." Not all parents managed to resist taking over the task, and not all recognised the value of specific feedback from which a child could learn. However, it was just such activities that the facilitators sought to encourage in parents, with some success.

This collaborative or scaffolding model of parental engagement was enacted differently depending on the age and abilities of the child(ren). Parents of younger children collaborated more physically and their artefacts reflected more of a co-design process in which the parent had been nearly as involved as the child. Often, we observed a parent-child pair crowding together over a task, or a child sitting on a parent's lap, or the parent physically holding a hand over a child's hand or helping open and close scissors. In such ways, parents acted as children's 'eyes' and 'hands', helping them see the potential in materials and physically realize their designs. Such physical intimacy supported collaboration in ways that professional facilitators cannot generally undertake (Sheridan et al., 2014).

Parallel play

In some cases, we found that parents and children engaged in making in close proximity to but in some ways separate from each other. We thought of this as ‘parallel play’ (drawing on the term from early childhood development research).¹¹ For example, at LHS, we met grandparents (White) visiting the Bay Area from Pennsylvania attended a ‘jitterbots/artbots’ session in the makerspace with their five-year-old granddaughter. The activity involved making circuits to animate a construction that would then draw patterns on a sheet of paper. The grandfather explained to us that he is a furniture maker, so while he was new to the concept of circuitry he understood how to make a stable construction. The girl worked mainly with her grandmother who acted as a collaborator, while her grandfather was sat next to her making his own construction. The three quietly concentrated on constructing their bots, with the girl occasionally glancing at her grandfather’s progress, iterating ideas for her own bot – and sometimes they swapped objects to check out each other’s creations.

Some facilitators reflected on these scenarios, describing how they would specifically give materials to a parent to encourage them to play and experiment alongside their children. For example, a facilitator from The Tech told us that if she saw a parent taking over too much she would

“introduce a new set of materials for them to both work on projects independent of each other or next to each other but they are both working on their own projects. And then you can play up the ‘try them out against each other and try to learn from each other’s’.”

We saw similar scenarios multiple times, especially with older children engaging in friendly competition with parents to create effective designs. Sometimes this competitive edge backfired, with parents taking over by *directing* their children’s designs and preventing them from pursuing their own ideas.

As noted, parents did not always stick within one of these categories but rather moved between and amongst them. For example, at The Tech Museum, we met a family of four – a father from India and an Indian-American mother with an eight-year-old boy and an eleven-year-old girl. The mother and daughter worked quietly side by side to each create their own version of a Mars Rover which could, powered by a fan, deliver a 3D printed cupcake up a ramp and over a gap. Each created their own design, walking back and forth from the trial table to the materials table to iterate and improve their design after testing it. The father, who described himself as an engineer, worked with the son directly, creating a shared idea that varied between the son’s initiative but with the father increasingly directing the action by telling where the son to put the ballast on his small ‘ship’. The father announced “it’s a competition!”, before egging on not only his wife but also his son and his daughter to see who could create the most aerodynamic design. At times the dad heavily directed the son, physically lifting the design out of his hands to make something more secure; still, after tinkering with the design for a few moments he generally

handed it back to his son to continue iterating – changing the direction of the sail and ensuring a smooth journey.

Parents as connectors

Although one might be tempted to judge some of the parents – especially those ‘babysitting’ for being too hands-off or those ‘directing’ or taking over for being too controlling – we have instead sought to understand how they may be tailoring their actions (or inactions) in accordance with their own understandings, skills and values, as well as the needs of their children. Our initial views of the parents were frequently challenged by talking to them, at times leading us to turn a critical lens instead on the facilitators, especially in their assumptions about parents and parental understanding, and the design of the makerspace and the degree of welcome it offers.

One specific contribution of the parents – easily overlooked by the facilitators during the busy sessions – was the work they did in connecting their child’s learning experiences across sites, helping them make sense of the makerspace activities in relation to other parts of their lives. For example, at LHS we observed a Native American mother building artbots with her two young daughters (three and five). She linked the activity to other things they had seen in the museum, and other lessons they had participated in as part of their small community of home-schooled families, for instance explaining how the artbots were ‘like R2D2’ (a reference to the girls’ love of Star Wars). At the same time, she looked to the professional facilitators to explain the scientific concepts to her daughters so she could build upon them. As one facilitator observed, parents can be helpful in the makerspace

“because they know that child so much better than a facilitator would know them and just having met them for the first time ... a parent may know better how far they can challenge their kids.”

Another commented that

“one powerful thing that the parents can do is help to bring that back to the connected learning throughout their life. So, you know, if they can call attention to something that they did that was similar in another place, or say, like: Oh do you remember when we were trying to do this thing, this is really similar to this. Like, how would you apply what you learned there, here.”

This facilitator’s use of the term “connected learning” was independent from the learning theory of the same name, but it supports our argument that parents can play a key role within the learning ecosystem that surrounds a child. Although we expressed concerns earlier about the role of smartphones recording makerspace activities, we also recognise that one practical way in

which many parents attempted to connect a child's learning is by taking photographs or video of the child's creations, thereby providing a vehicle for revisiting the experience later, although it is unclear whether in practice many in fact did this.

Ultimately, our observations of parents have led us to advocate for an asset-based approach to understanding the role of parents in makerspaces. By an asset-based approach, we mean that typically perceived deficits can instead be considered assets, bringing something unique to a particular encounter (Alper et al., 2016). Here this means that while in some cases parents felt themselves to be, or were considered by facilitators, lacking in knowledge when they entered makerspaces – they nonetheless present a powerful and highly unique asset by supporting children's making by connecting their learning between and across spaces.

While professional facilitators were informed by institutional theories of learning, and viewed parents sometimes as too 'hands-off' or, alternatively, too 'hands-on', they also acknowledged (as we observed) that parents were drawing on unique "repertoires of practice" (Gutiérrez and Rogoff, 2003) or "funds of knowledge" (González, Moll and Amanti, 2005). These repertoires were informed not only by the parents' own sets of knowledge and experiences – including their sense of self-efficacy – but also their understanding of the interests and strengths of their own child(ren). Some parents saw themselves as learning resources by helping directly steer their children within activities, while acquiring new skills (Martin, Erete, Pinkard and Sandherr, 2017; Roque, Lin, & Liuzzi, 2016). Others consciously disengaged from children in order to give them space. Even those parents who did not take part in activities at all often had their own 'theory of learning' that had led them to bring their child to the makerspace in the first place (Sefton-Green, 2013).

Conclusion

In this chapter we have considered the design of the physical and social space, the perspectives of facilitators and the roles for parents in three museum makerspaces in order to understand the different ways in which intergenerational learning occurs through 'making'. What we have also noted is the very different ways in which parents support children through making, as opposed to professional facilitators.

Parents presented a different form of support to children from the professional facilitators also present. Parents' intimate knowledge of their children, knowing when to push and what might motivate, was also complemented (especially for parents of younger children) by their physical intimacy and ability to help children when needed. However, in some cases, that intimate knowledge could also occlude parents' ability to see when they needed to step back, an outside perspective that professional facilitators were sometimes more able to assess. Facilitators also

had greater subject knowledge of making itself, professional knowledge that in ideal cases worked in tandem with parents' more intimate but hard-won expertise.

Reading through the typology above one might be tempted to produce normative analyses of parents based on their behaviour – the hands-off parents too uninvolved, the hands-on parents too 'helicopter-y'. Yet in our observations we saw that parents often made reasoned choices (based on their knowledge of their children) as to why they chose one role over another, or their own experiences or pressures framed these choices in more or less beneficial ways. We suggest that creating this typology of parent actions (rather than of individual parents, for some moved between and amongst these categories) is helpful in elucidating these differences and, hopefully, in providing some reflections that can be shared with the facilitators to help develop new initiatives and support for parents, either separately or together with their children, in the future. Our observations of parents lead us to argue that parents play a unique role in collecting children's learning in makerspaces. They are experts not in 'making' but in their *own children* – and this makes them able to foster helpful interactions grounded in the intimacy of their relationships. Facilitators and parents, when operating in tandem, can together help develop new forms of shared knowledge creation by building on children's enthusiasm for and engagement with making – and bring this knowledge and experience to bear after the making experience has been completed.

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¹ Research for this chapter was made possible by the Horizon 2020 programme grant no. 734720 for the MakeEY project and by a grant from the John D. and Catherine T. MacArthur Foundation as part of the Connected Learning Research Network. Our thanks also to Paige Mustain for editorial assistance and to the staff from The Tech, Bay Area Discovery Museum and the Lawrence Hall of Science for their generous help in facilitating this research.

² From the BADM website, accessed 8 December 2018, “Bay Area Discovery Museum” (n.d.)

³ The Fab Foundation was created at MIT and encompasses a network of about 1,000 fabrication labs meant to provide access to digital fabrication. The Fab Foundation and maker culture stem from MIT Professor Seymour Papert’s theory of constructionism which posits that learners construct their own knowledge by making and tinkering with objects and having agency over the learning process (Papert, 1980).

⁴ 3D printers create three-dimensional solid objects from a digital file by printing layers of material until the object is complete. A laser-cutter is a machine that uses lasers to precisely cut through a wide range of materials. A CNC (computer numerical control) router is also used to cut various materials, such as wood, plastic and steel.

⁵ By which we mean an adult with caring responsibility for a child – in practice in our fieldwork this was usually parents, occasionally grandparents or another family member (an aunt or uncle, an older sibling) or a paid caregiver like a nanny. Because the focus of our research was on families we spent less time with paid caregivers and do not include observations of professional teachers in this chapter. For ease we will refer to ‘parents’ and specify cases where we observed a caregiver of a different type.

⁶ We use the term ‘facilitator’ in keeping with our previous work on digital media and learning (Blum-Ross and Livingstone, 2016), which draws from Paulo Friere’s (1980) conception of ‘critical pedagogy’ in order to distinguish between ‘facilitators’ who enable participatory learning versus ‘teachers’ who may be more traditional in their approach as givers of information.

⁷ Tinkercad is a free browser-based app that allows users to create 3D designs (“Tinkercad”, n.d.).

⁸ Their schools programme welcomed anyone who signed up, but they – like the other museums – had also created special outreach for ‘Title 1’ schools (schools with a high percentage of students receiving free or reduced-cost lunch, a national poverty marker in the US). (Dawson, 2014).

⁹ Our research for Parenting for a Digital Future (Livingstone and Blum-Ross, forthcoming) revealed the multitude of ways in which everyday family activities already resemble maker experiences – think of crafting, gaming, cooking, DIY or various forms of play, many of which now involve YouTube tutorials or other kinds of ‘joint media engagement’ (Takeuchi & Stevens, 2011, see also Gauntlett, 2011; Barron & Levinson, 2018).

¹⁰ See Roque (2016) as an example of studying parental involvement.

¹¹ See Parten (1933).