Impact of physical and social settings on parent engagement in learning through making

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Abstract

Previous research has documented the benefits of making for young learners, but few studies have examined how parents engage in maker activities during family visits to museums, both as facilitators of their children's learning and as makers in their own right. In this study, we asked how caregivers participate in making and tinkering programs, how parents describe the benefits of making (for their children and themselves), and what aspects of the physical and social setting influence parents' engagement. Data included observations of 88 family groups participating in various making and tinkering activities at a science center (including woodworking, fashion design, virtual reality drawing, circuit blocks, etc) and exit interviews with a subset of 66 caregivers. Qualitative data analysis connected observed qualities of the physical and social setting with caregivers' observed and reported engagement. Through this analysis, we identified specific aspects of the physical environment, tools/materials, and facilitation strategies that invited family participation in general and that were associated with specific caregiver roles, including observing children's learning, facilitation of children's learning, and engagement as a maker alongside children. The implications of the findings for the design and facilitation of maker programs are discussed.

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Introduction

Previous research has documented the impact of maker experiences on many aspects of children's STEM learning, including content knowledge, self-efficacy, and interests (see Vossoughi & Bevan, 2014, for a review). However, few studies have examined how parents participate in maker programs in museums, both as facilitators of their children's learning and as learners in their own right. Studies on children's participation in maker programs have demonstrated that family interactions are critical in supporting and guiding children's learning over time (Brahms, 2014; Brahms & Crowley, 2016). Despite the important role that parents play in these learning experiences, we know relatively little about what draws family groups to maker programs or how maker spaces can be designed to support caregivers and children together. Furthermore, parents' perceptions about the benefits of making for their children and themselves remain relatively unknown. Because parents act as gatekeepers for a variety of informal learning experiences, parents' engagement can have consequences for children's ongoing opportunities to learn through making and build identities as STEM learners.

Theoretical framework

Our approach draws on three bodies of research: 1) research on informal learning in museums, which describes learning as a sociocultural process, with caregivers supporting children's learning and emerging interests (Crowley & Jacobs, 2000; Falk & Dierking, 2000; Zimmerman, Reeve, & Bell, 2010); 2) community psychology interpretations of physical and social settings as jointly influencing behavior at the individual, family, and community level (e.g., Gomez & Yoshikawa, 2017); and 3) research on the physical and social affordances of informal learning environments, which has identified numerous design principles that can

support learners' engagement in free-choice settings (Allen, 2004; Borun, Chambers, & Dritsas, 1997; Dancstep & Sindorf, 2018; Falk & Storksdieck, 2005; Humphrey & Gutwill, 2005). Some of this research has specifically focused on the arrangement and facilitation of making and tinkering spaces (Sheridan, et al. 2014; Gutwill, Hido, & Sindorf, 2015).

Based on this prior work, in this study we view families as systems in which parent engagement impacts children's learning, and argue that physical design and facilitation strategies within maker spaces contribute to parents' participation and engagement. Research questions were: 1) How are parents involved in maker programs at museums?; 2) How do parents describe the benefits of making, for their children and themselves?; 3) What aspects of the physical and social setting influence parents' engagement and perceptions of their experiences?

Methods and data sources

Data included observations of 88 family groups and exit interviews with a subset of 66 caregivers in a variety of maker programs (e.g., woodworking, virtual reality, fashion design, circuits). Observations noted parents' roles (observing, facilitating children's learning, engaged as makers), qualities of the physical and social setting (e.g., environment, tools/materials, facilitation). In semi-structured interviews, parents described the activity, the benefits of participating for their children and themselves (including STEM learning), and their prior experiences with making at home or elsewhere. Inductive qualitative analysis using grounded theory methods (Charmaz, 2006) and sensitizing concepts from prior research (Bowen, 2006) connected observed qualities of the physical and social setting with parents' observed and reported engagement.

Results

Caregiver roles. Most caregivers showed one predominant role throughout the observation and interview. Of the 88 families observed, caregivers were most often engaged in facilitating their children's activity (38%) or observing (30%), with fewer involved in making alongside their children (21%). For the remaining 10% of caregivers, observations and interviews did not provide sufficient evidence to establish a single predominant role.

In interviews, caregivers described different benefits of making for children and for themselves, depending on their roles and motivations for participating. Caregivers who were primarily engaged in observing prioritized children's independence and described noticing children's interests and abilities while watching them approach a new learning experience. In contrast, caregivers who took on a facilitating role emphasized spending time with their children and described learning from facilitators about activities they could do at home or ways they could help their children. Caregivers who were engaged as facilitators and as makers described the process of creating something by hand as beneficial for their children. However, those who were engaged as makers also described many benefits for themselves as adult learners, including building their own creativity and following their own interests.

Role of the physical and social setting. We identified factors that were associated with caregivers' participation in making and tinkering programs, and that shaped the ways that they were involved. A description of the qualities of the environment that were associated with different caregiver roles is provided in Table 1.

Table 1. Summary of design factors associated with caregivers' engagement

	Observing	**Facilitating**	**Making**
Visibility	Open sight-lines; proximity to other exhibit areas		
Invitation to explore	Examples of finished products; Immediate engagement with materials		
Arrangement of materials	Individual stations; Seating along periphery	Individual stations or communal seating with shared pools of materials	Communal seating with shared pools of materials
Novelty & familiarity	Either familiar or novel materials	Familiar materials used in novel ways	Novel tools and materials
Facilitation direction & timing	Facilitation directed at children	Facilitation directed at adults	Facilitation directed at both adults and children

Some factors were associated with greater participation and engagement across all caregiver roles: caregivers were more likely to participate when activities took place in spaces with *open sight lines*, rather than enclosed spaces. For example, when woodworking tools were moved from a separate maker space to an open exhibit area visible from a distance, more families participated and groups stayed longer. In addition, the *proximity to other exhibits and programs* supported families' participation, because families with multiple siblings often split up, and caregivers would seek out spaces where children playing in different areas could still be visible. Finally, observations revealed multiple ways that maker space staff provided *invitations to explore* — not only through verbal invitations and welcomes, but also by allowing visitors to immediately start using tools and materials with minimal direction, and through the display of finished products as inspiration. These findings suggest some simple ways that maker spaces can be designed to invite families in, regardless of caregivers' roles and preferences.

Other aspects of the physical arrangement of the space or the facilitation strategies employed had an impact on how caregivers were involved in children's learning. The arrangement of materials into individual or communal work areas influenced where caregivers

were physically located and, therefore, the roles that they tended to play. When programs were set up with *communal seating areas* where visitors (and staff) shared the same pool of materials, caregivers were more likely to work side-by-side with children, which supported them in both facilitating and making. In contrast, when activities were set up with *single stations* (for example, a small table with one set of woodworking tools), caregivers were more likely to sit next to or opposite children at the table and to be involved as facilitators or observers rather than makers, depending on facilitators' availability and level of involvement.

In general, caregivers described being interested in the programs primarily because they did not have access to the same tools, materials, and expertise elsewhere. However, the relative novelty of the materials influenced parents' involvement and responses to the programs. *Novel tools and materials* (e.g., virtual reality goggles, 3D pens, scroll saws) and motivated parents to engage directly in making, with many describing learning new skills as a key benefit for their own learning. In contrast, *familiar tools and materials* (e.g., fabric, collaging, hand tools) supported parents as facilitators of their children's learning, and caregivers were more likely to link the maker programs to children's other interests or experiences at home or in school.

Finally, the direction and timing of facilitation influenced caregivers' involvement. Light-touch facilitation, in which facilitators gave a brief introduction and then faded into the background, was observed across many observations, and when this kind of assistance was directed *toward caregivers*, it was followed by caregivers taking on a facilitating role. When facilitation was directed *toward children,* caregivers were more likely to defer to the facilitator and observe. However, this style of facilitating occasionally allowed caregivers to work on their own projects as makers — for example, if facilitators stepped in to help children when they observed caregivers deeply involved in their own work. These results suggest that the

involvement of facilitators (especially early in the activity) can either promote or detract from caregivers' engagement in the activities. Light-touch facilitation was also more responsive to families' strengths and prior knowledge, as facilitators spent more time observing how families were interacting before offering their assistance.

Significance

This study highlights the complex interplay between physical and social qualities of maker programs, and their impact on parents' engagement. The results are novel in that they offer specific design and facilitation strategies for supporting parents themselves as makers within family programs. More generally, the findings suggest strategies that maker spaces can use to welcome family audiences, and to recognize and support the variety of roles that caregivers can play within these programs. Further, the results highlight multiple motivations that families have to participate in maker programs during family visits to museums. Caregivers in this study recognized the benefits of making for many aspects of their children's learning, as well as for their own learning, parenting practices, and well-being, and responses varied depending on how caregivers chose to engage with the programs.

Observations and interviews showed that aspects of the physical and social setting could support family participation and predispose caregivers to take on different roles — for example, by encouraging observation from a distance, or by making space for caregivers to be the primary facilitators of children's learning or to engage in making as learners in their own right. These results have many implications for the development and implementation of maker programs. In some instances, maker programs may wish to encourage a particular role for caregivers — for example, prompting caregivers to observe in order to support children's independence and self-

confidence, or prompting caregivers to engage in making in order to support them in exercising their own creativity alongside their children. Each of these educational goals has distinct design and facilitation implications (e.g., choosing to direct assistance toward caregivers versus children, or choosing individual versus communal work stations).

Alternatively, by being aware of the ways that caregivers approach maker programs and respond to aspects of the physical and social environment, maker programs can be strategic in using complementary and inclusive strategies to support diverse family groups. In particular, light-touch facilitation practices that invite immediate exploration by visitors of all ages and provide just-in-time support can create space for caregivers as makers within family programs, while also responding to caregivers' needs regardless of the roles they choose to play.

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