Board 169: Making Families Aware of Engineering through the Public Library (Work in Progress)

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This work in progress reports findings from a pilot study conducted as part of an NSF-funded project (NSF DRL 1759259) with the goal of engaging children in Grades 3-6 and their caregivers in engineering activities by collaborating with the local public library. The goals of the larger project are to increase the awareness of children's and caregivers' awareness of and interest in engineering. To increase the impact of the project, this pilot study sought to partner with the local library to distribute STEM kits to families. We believed that such a collaboration would be mutually beneficial. Namely, the project would benefit from the libraries' existing infrastructure for kit distribution and programming, and libraries would benefit through being able to distribute free, ready-made kits to local families in their communities looking for STEM content. This pilot study focused on answering the following research questions: 1) Does offering STEM-kits through the library reach families who may not typically have access to STEM activities?, and 2) What impact does participation have on families?

While libraries typically are thought of as providing support to the development of literacy, libraries have begun to play an increasing role in the support of making and STEM activities. There are over 100,000 libraries in the U.S. that serve a wide range of communities and needs [1], [2]. Libraries are open to the public and often have established trusting relationships within their communities, which allows them to reach a wide population, "especially those who haven't been seen as the dominant view of the white, male, STEM-motivated public face of making" [3]. Through their focus on equity, access, and lifelong learning, libraries are uniquely situated to serve populations that do not feel welcome at formal, membership-driven makerspaces or who have typically been underserved or underrepresented in STEM [3]. The primary aim of public libraries is to provide people with access - to information, resources, other people, and various programming [4]. As such, libraries provide a partnership opportunity to extend making and STEM opportunities to their community members. Our project team aimed to use existing efforts in our community to address unequal access to quality STEM learning opportunities. Public libraries, for example, have provided community family learning opportunities with qualified STEM programs [5] that offered a place for sharing knowledge and information between caregivers and children and family regardless of income levels [6]. The U.S. Department of Education's STEM 2026 initiative also has selected public libraries as collaborative partners in facilitating children's career aspirations in STEM through family engagement [7]. Such family engagement in STEM at public libraries often occurs as one-day events or theme-based events. One example of a family engagement event involved children engaged in the making process and conversation with experts and caregivers as they designed a lunar rover [8]. In another family workshop, caregivers used discussion prompts to facilitate science-related conversations with their children that sought to connect abstract concepts, rural life experiences, and scientific knowledge [9]. Both programs highlighted the role of public libraries' STEM programs as a

means to contextualize STEM in families' daily experiences. Public library programs also have integrated STEM subjects into the existing literacy program with an emphasis on parental engagement. Caregiver-child interactions during making activities often are key elements of these programs, allowing families to engage with STEM content and to use making as a means for children's vocabulary understanding [10]. Additionally, STEM and STEAM kits have been circulated across rural libraries as part of family STEM programs, such as when Washington State libraries distributed project-based STEM and STEAM kits (e.g., Egg bot) that contained the main materials for creating a well-shaped final product [11]. While public libraries provide a unique, tangible network for qualified STEM learning opportunities regardless of families' backgrounds, less is known about the feasibility of partnering with the library to provide STEM activities to families to engage in together in their home environments. This pilot study attempts to better understand the potential of such a partnership by integrating at-home STEM activities with a local libraries' summer reading program.

Methods

The Summer Family STEM Reading Challenge was developed as a pilot project to lower the threshold of participation in STEM activities by distributing STEM kits through the local library as part of their annual summer reading program. This study explored whether offering STEM kits through the library reached families who may not typically have access to STEM activities and what impact participation had on families. While we have worked with our local library previously, they were initially hesitant to engage with us on this project due to the logistics of kit circulation and concerns with how kits would fit within their existing structure of their summer reading program. To allay the library's concerns, we worked out a plan to utilize their existing activity registration system to sign families up and their main branch for distribution. Our team responded to all email inquiries from the participants, provided weekly online Q&A sessions, and restocked used materials in kits. The library maintained control over registration and communication with families, including all personal identifying information. Our library partners noted that they appreciated that we worked within their parameters of lead time for planning of the summer program as we worked to identify and address their needs related to support materials for the program. Second, the library partners noted that we need to keep in mind that even though we agreed to respond to all participant inquiries, the library staff were the direct points of contact with families as they interface with patrons who engage with the kits, answering questions that families have about the kits and overall process. As such, we need to find ways to help library staff be aware of the program and informed about the details.

We offered four separate kits as part of this pilot study: *Roller Coaster*, *Squishy Circuits*, *Trendy Tennies*, and *Watercolor Bots*. Kits came in a plastic container that included a set of instruction cards, materials for use, an Engineering Passport (one per kid) and stickers, and a postcard with recommended books they might read. The kit directions walked families through the cycle of Design > Plan > Create > Test > Improve. Although each kit included a specific design

challenge, we sought to create challenges that were specific enough to provide directions to guide their making, but open-ended enough that families could take their build in any direction they wanted. Materials for these kits are available on our project website: athomeengineers.com.

Registration was opened for each kit individually and was capped at 35 families per kit. Registration for all four kits was filled within the 1st week after being advertised via the library newsletter and website. Although we took this as a strong indication of interest, our lead partner at the library said that this indicated that the families who registered right away were likely those who were already well-connected to the library and/or who already were interested in STEM activities. She thought it was likely that we did not reach those who are less economically advantaged or those who lack STEM resources. She also shared that the initial surge in registrations when programs open often is not accompanied by follow-through by all families, with a large number of "no-shows" or cancellations. These "early bird" registrants may take up spots of others who are interested but were unable to register or who were placed on the waiting list. We are not certain about the best ways to address this in future iterations.

Findings

We collected data that would inform us on the efficacy of the partnership but that also would inform our research on engaging families in engineering. Families completed an intake survey at registration, recorded their engagement in the kits via a unique Zoom video link, and completed a post-survey at the end of the summer program. Additionally, we gathered field notes during interactions with library staff and families, and we conducted informal conversations and formal interviews with library staff throughout and at the end of the program.

All registration and data collection requests were sent through the library which led to lower completion rates. As such, it was challenging to determine how many families participated overall and how many children from each family participated since each kit had a separate registration. Forty-three families completed the intake survey. Just over half of families indicated that they registered for one kit (n = 23, 53%), followed by families who registered for all four kits (n = 10, 23%) or for two kits (n =8, 19%). Two families (5%) were unsure how many they had registered for. Twenty families indicated they only had one participating child, while 23 families had between 2-4 children, for a total of 70 children across the families. Parents reported the gender of their child(ren), with a 2:1 ratio of boys to girls (boys n = 47, 67%; girls n = 23, 33%). On average, children were 8.8 years old (SD= 2.4). Approximately 80% of parents (n = 34) indicated that their child participated in STEM activities weekly, daily or multiple times per day. Using a 5-point scale, parents rated their ability to help their child(ren) in their STEM learning in science (M = 4.2, SD = .68) and math (M = 4.3, SD = .69), noting high ability in both content areas. Additionally, we asked parents to rate their interest in STEM careers as a potential career for their child(ren), with parents indicating strong interest in such careers (M = 4.5, SD = .67). Finally, we asked parents to briefly indicate why they or their children wanted to register

for the Summer STEM Reading Challenge. Seeing the kits as an educational opportunity was mentioned frequently, particularly as a way to keep children engaged during the summer. Other parents focused on interest – either triggering it or maintaining it – with responses mentioning encouraging interest in STEM or that parents want to support their childrens' love of science, STEM, building, etc. One response exemplified the feelings of most responses: "My son can't stop designing and building things out of cardboard!! He loves engineering in general and wants to be an 'inventor' when he grows up. Thought this would be a nice change and new challenge for him - right up his alley." These results provide evidence that the families participating in this challenge tend to already be STEM-interested/engaged, and we did not see any responses that indicated hesitation or lack of interest in STEM.

A total of 18 families completed the post-survey. Of the 28 children across these families, on average children were 9.25 years old (SD = 2.2) with an equal distribution of girls (n = 13, 46%) and boys (n = 14, 50%). One child was identified as non-binary. Using a 5-point scale, families indicated that they were satisfied with the registration process (M = 4.7, SD = .46) with all respondents selecting 4s and 5s. Participants indicated multiple things they liked about the kits, with one caregiver stating, "I liked that the child gets to choose her client and design a product specifically to that client's needs. I like that my daughter learned that research is the first step to creating something new. I liked the question prompts that came with the kit for me to ask my daughter as she was going through the design process." When asked about aspects of the kits that could be improved, the few comments shared indicated that users might benefit from YouTube videos that give some guidance on each kit. Similarly, when asked what challenges they faced when completing the kits, most parents indicated that they needed more time to complete the kit activities and that their kids often were impatient. Conversely, when asked about the benefits of participation, caregivers noted that kits gave them a chance to engage in STEM activities, with one parent stating that the kits provided "an opportunity to talk about experiments and creativity." Another parent noted the impacts on their child's perceptions of STEM, stating "She [my daughter] says she likes STEM and engineering... those words have meaning to her now."

After the summer program concluded, we conducted a debrief session with our primary library contact who was the head of children's services. One of the ideas that surfaced was that although we shared a goal for families to learn together, it is likely that most families chose not to or were unable to engage in the ways that we hoped for. We have to recognize that families have a lot going on and may not be able to complete all components or engage fully, but we may have to aim for a middle ground of engagement. Additionally, families may be less comfortable with open-ended activities, so additional support may be needed to guide families through this type of activity. The other main topic that came up was that we should try to find ways to better connect the activities in the kits to the library resources (e.g., books) around kit topics. Our contact shared, "One thing we might consider is instead of having different kits is maybe producing one kit, possibly two. And building it around a book that we know can be purchased or acquired and

perhaps even given to every family that would participate in trying out that kit…[or]…not worrying about pairing a specific book with a kit, but really trying to emphasize the idea of there's a lot of different books that could help enrich your understanding of this concept."

Summary

This pilot study attempts to better understand the potential of partnering with the local library to provide STEM activities to families by integrating at-home STEM activities with a libraries' summer reading program. We sought to partner with the local library for multiple reasons: 1) libraries reach a broad and diverse community, particularly those not typically represented in STEM fields; 2) libraries can provide free and inclusive access to making; 3) pairing books with STEM activities increases background knowledge and vocabulary in context; and 4) families are increasingly engaging in STEM activities offered at libraries to support and foster their child(ren)'s learning. Below, we discuss four primary lessons learned as part of the pilot Summer Family STEM Reading Challenge. First, we did not quite reach as diverse an audience as anticipated. We had a limited supply of kits, and they were reserved quite quickly, leading to kits likely going to families already well-connected to the library and/or interested in STEM activities. Second, the partnership with the library did successfully provide free access to STEM activities to families as all kits were registered for and picked up, but the implementation required heavy support from the research team. Future library partnerships will need to keep in mind the multi-layered administration system of public libraries, discuss clear expectations for program outputs and outcomes, and involve all library stakeholders in the planning, especially the library staff who directly interface with participating families. Third, we were not successful in pairing books with the kits. While we were able to provide a recommended reading list for each kit, there was not a budget to purchase enough copies to include with each kit. One option for the future would be to explore offering access to eBooks when possible to these books. Finally, while there was evidence that families did not engage in the ways that we intended (e.g., completing kits together) or that they struggled with the open-ended nature of the activities, initial findings suggest positive impacts on children's interest in STEM and their opportunity to engage in these types of activities. Future iterations could more clearly describe the open nature of the activities and provide additional resources to scaffold participation in them.

This pilot study presents one example of an attempt to collaborate with a local public library to provide STEM kits and experiences to families. Our findings highlight both challenges and successes with such a partnership. While we had moderate success in our first iteration, forming partnerships with other organizations with a synergistic focus is not a simple process as there are a lot of factors to consider in order to be successful and mutually beneficial. As such, we conclude that simply providing an "add-on" activity to an existing program is not likely to be successful. In our next iteration, we plan to work with additional libraries in other parts of the country who currently offer maker programming and work collaboratively with these libraries to incorporate the STEM-kits as an extension of their existing programs.

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References

[1] K. Rosa, K. LibGuides: Number of Libraries in the United States: Home, 2019. Retrieved from https://libguides.ala.org/numberoflibraries

[2] V.R.Lee, "Libraries Will Be Essential to the Smart and Connected Communities of the Future," in *Reconceptualizing Libraries: Perspectives from the Information and Learning Sciences,* V. Lee & A. Phillips, Eds. London, UK: Taylor & Francis, 2018

[3] A. Simpson, & A. Maltese (2019). "Developing and using low-cost MAKEngineering kits for youth engagement," *Teacher Librarian*, vol *46, no.* 5, pp. 14-17, 2019.

[4] A. Lakind, R. Willett, & E.R. Halverson, E. R., "Democratizing the maker movement," *Reference & User Services Quarterly*, vol.58, no. 4, pp. 235-245, 2019.

[5] M.E. Lopez, L. Jacobson, M. Caspe, & R. Hanebutt, "Public libraries engage families in STEM," *Global Family Research Project*, 2019.

[6] N.S. King, Z. Collier, B.G. Johnson, M. Acosta, & C.N. Southwell, "Determinants of Black families' access to a community‐based STEM program: A latent class analysis," *Science Education*, vol. 105, no. 6, pp. 1100-1125, 2021.

[7] C. Tanenbaum, T. Gray, K. Lee, M. Williams, & R. Upton, "STEM 2026: A vision for innovation in STEM education," US Department of Education, Washington, DC, 2016.

[8] H.T. Zimmerman, K.E. Grills, Z. McKinley, & S.H. Kim, "Families' engagement in making activities related to aerospace engineering: designing for parents as learning partners in pop-up makerspaces," *Information and Learning Sciences*, vol. 123, no. 3/4, pp. 154-178., 2022.

[9] L.R. McClain, Y.C. Chiu, & H.T. Zimmerman, H. T., "Place‐based learning processes in a family science workshop: Discussion prompts supporting families sensemaking and rural science connections using a community water model," *Science Education*, vol. 106, no. 3, pp. 645-673, 2022.

[10] D.C. Celano, J.J. Knapczyk, & S.B. Neuman, "Public libraries harness the power of play," *YC Young Children*, vol. 73, no. 3, pp. 68-74, 2018.

[11] "Between the lines, " WSL Updates for December 3, 2015. *Washington State Library Blog*, (2015, December 5. https://blogs.sos.wa.gov/library/index.php/2015/12/wsl-updates-for-december-3-2015/