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Creating online supports for at home making and STEM projects during COVID-19 (Work in Progress)

Adam Maltese (Martha Lea and Bill Armstrong Chair for Teacher Education)

Professor in Science Education at Indiana University.

Kelli Paul

Dr. Kelli Paul is a postdoctoral researcher at the Center for Research on Learning and Technology at Indiana University where her research focuses on the development of STEM interests, identity, and career aspirations in children and adolescents.

Amber Simpson (Assistant Professor)

Amber Simpson is a Assistant Professor of Mathematics Education in the Teaching, Learning and Educational Leadership Department at Binghamton University. Her research interests include (1) examining individual's identity(ies) in one or more STEM disciplines, (2) understanding the role of making and tinkering in formal and informal learning environments, and (3) investigating family engagement in and interactions around STEM-related activities. Before joining BU, she completed a post-doctoral fellow□ship at Indiana University-Bloomington. She earned a Ph.D. in mathematics education from Clemson University

Ariel Zych (Director of Audience)

As Science Friday's director of audience, Ariel Zych actively leads the engagement, learning, research, and impact strategies and activities at Science Friday, working to make science exciting, accessible, equitable, and representative to a growing national audience.

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Introduction

Our project looks to address the large-scale shift to at-home learning based on nationwide school closures that occurred during COVID-19 by creating maker/STEM activities for families. Our CoBuild19 project team developed approximately 60 STEM activities (see cobuildathome.com) for children in grades K-6 using items readily available in most households and delivered fully online. The activities were designed through collaborations with museums, maker education groups, teachers from K-12 and education researchers.

In early March 2020, there were a few hundred confirmed cases of COVID-19 cases in the US and this number increased by a hundred-fold in just a month [1]. This jump in cases forced the concomitant closure of many businesses and schools, with most states shutting down schools by April [2]. This situation led to millions of kids being at home without well-formed instructional plans and caregivers in the position of being their primary educators while schools scrambled to get their legs under them.

Project Timeline

In early March we sensed that there was a strong possibility schools would close for at least a few weeks and that caregivers would be left trying to figure out how to fill the days without completely turning to TV and video games. To address this need and opportunity, we gathered a team of educators together with expertise in making and STEM education. We planned to create and share activity ideas with caregivers through an associated Facebook group (CoBuild19). The team started a Facebook group on March 13. Membership in the group grew to 3490 by April 1 and 4245 by May 1 and leveled off at approximately 5000 members in June 2020, without much change since that time. As of March 5, 2021, members are primarily from the United States (4510), Mexico (43), India (42), the UK (37) and Japan (28). In the US, members most commonly hail from Indiana, California and Iowa. Facebook reports that 86% of the group members are female and over 40% of the group falls in the 35-44 age range.

From March through June 2020, we produced and shared videos and activity guides, averaging a handful of new activities per week. Generally, each activity we created involved a video and/or a user sheet. These resources were meant to be more toward the end of an activity starter than they were intended to be a complete recipe that would produce exact replicates across all families that completed it. In the beginning, the activities consisted of whatever team members could pull together, including *From Junk to Journal*, *DIY Slide Whistle*, *Leprechaun Traps* and *DIY Puzzles*. As things progressed, we tried to create themes for the weeks and associated activities,

including *Design and Prototype Week*, *Textiles Week*, *Social and Emotional Learning Week*, and one week where we highlighted kids sharing cooking and baking recipes for other kids. Some of the engineering activities included: *Heat Shield Design Challenge*, *Wind-powered delivery devices*, *Build your own grabbers*, *Using design and engineering to build a wind car*, and others.

As the project was starting, we were already thinking about how to make the project sustainable and use this opportunity as a chance to do research. We garnered funding from Infosys Foundation USA and a RAPID grant from NSF toward these goals. The research aim of the project was to investigate strategies for enabling families to actively engage with STEM while at home during the pandemic. Our initial research plan was to collect and analyze social media data to refine and improve the activities and programming and learn about the ways families engaged in the activities. We soon found that our videos got many views, "Likes" and other positive metrics. To date, 23 of our videos have more than 1000 views, with the highest garnering 23K views. However, we got very few submissions of videos, images, or text about what families were creating, which limited our possible analyses. There was some participation and group contributions by members of the group when we started out but as the group grew in size substantive evidence of participation, in the form of posted pictures of kids' projects, comments, and questions from the participants, faded. We decided to go directly to the source and polled members of the Facebook group about their use of the activities. The responses (n = 101) were dominated by the option "*We are glad to know the ideas are available, but we are not using much*" (49%), followed by "*We occasionally do activities*" (35%). These responses were consistent with the lack of project submissions. With this happening, we had no data about home participation, so we decided to experiment with different approaches.

By late May 2020, we realized we could not sustain the pace of producing five activities each week. Because of this and our struggle to get evidence of participation, we decided to shift our focus and try new strategies. Once we finished the original planned content, we focused efforts on conducting virtual maker/STEM camps where we expected to see greater participation. We felt families and caregivers might view these are more "formal" or organized than activities provided via social media, thus they might be more likely to participate. These camps also filled a gap in in-person programming due to the closure of many summer camps. Our thinking was that having kids enroll in specific camp sessions would make it more likely we could get evidence of participation and give us the chance to work directly with kids and families. Our approach was to leverage the solid content produced in the first few months of CoBuild19 but to reformat it for camp.

We completed two rounds of Camp CoBuild by the end of July, serving close to 100 campers. Although the approach to offering content in this way brings with it some bias, the camps generated much richer data. These data are in the form of recorded Zoom sessions where campers make synchronously with educators and Flipgrid videos that youth create to share their

process and products for each activity. We also collected post-camp surveys and some interviews with caregivers. In our second camp, we experimented with the amount of facilitation guidance we provided to caregivers for each activity. We are in the process of analyzing these data to determine what range of engagement exists across participants and what malleable factors may be associated with deeper engagement. Initial feedback from caregivers indicated that their children gained some confidence to experiment with simple materials through engaging in these activities.

Following from the success of the summer camps, we wanted to experiment with other approaches to getting youth and families engaged. In reflecting on the activities we produced, we realized that the majority of the activities we created involved the science and engineering aspects of STEM but very little inclusion of technology. This was a purposeful choice since we did not want access to technology tools to be a barrier to participation. However, as we thought of ways we might extend the impact of CoBuild19, we decided to create an online club to try out engaging kids in Grades 5-8 in both engineering, design and computer coding, using the micro:bit, a popular microcontroller.

We structured the Design with Code Club (DwCC) to be different from other common coding offerings in that we wanted the main focus to be on kids designing solutions to problems that might include the use of technology and coding. We were purposeful in this decision for two main reasons. First, we wanted to make our coding club more interesting to girls, where previous research demonstrates their interest in designing solutions [3]. Second, we saw no reason to replicate the common format of programming instruction, where coding activities use programming as the core of instruction and application in authentic and student-selected contexts plays a minimal role. DwCC was set up so that each of the first four weeks had a different larger challenge that was COVID-19 related (e.g., “How can you communicate with a friend while staying socially distant?”), and sessions unfolded with alternating smaller challenges, discussion around design, and coding instruction that would develop their skills and knowledge of micro:bit capabilities. At the end of each session, participants were reminded of the bigger challenge and asked to work on their solutions and share them with others via Flipgrid before the next camp session. We culminated DwCC with an open-ended project where the kids were given the challenge of coming up with their own problem for which they might incorporate micro:bit as part of the solution. During Week 5 we focused on the initial parts of the design process, and in the final session (Week 6) we did our best to give them some design and coding guidance based on the problems they sought to address. We hoped that after Week 6 the participants would work on their solutions and share with the group via Flipgrid, which we incentivized by indicating we would send a package of electronics to those who participated after the final session, but no one did. We think this is likely because we did not set any sort of public display or sharing of these solutions. We are in the process of examining the data from the sessions and hope it will yield rich cases to see how boys and girls develop skills and engage in design and coding.

We advertised DwCC through Facebook and Twitter and had nearly 200 families register their kids to participate, and we had over 100 kids and adults engage in the sessions. Because we conducted all sessions online, we planned to use the micro:bit interface through Microsoft MakeCode to work with kids on the coding aspects as it includes a fully functional simulator. However, we realized that simulations are likely not as enticing as a physical object, so we set up the incentive that if youth participated in at least three sessions of the six-week club, we would ship them a physical micro:bit. In total 52 micro:bits were sent to youth: 10 kids completed all five activities, 16 kids completed four activities, and 29 completed three activities.

What's next? Although COVID-19 restrictions are on track to ease in many places and life is showing some signs of heading back toward normalcy, we are hearing from many educators that they are still planning for a significant portion of their offerings (e.g., museum activities) to be offered online or via hybrid format for the rest of 2021. Based on this, we plan to continue some form of content offerings during this time. We are currently considering ways we can get activities and materials out to those who are most in need by connecting through food pantries and meal delivery services. We are also trying to explore opportunities for youth to share about their experiences during COVID-19 and are exploring possibilities for other challenges. We were very excited at what we felt was a successful coding club. Since the original version, we planned a version for deaf and hard of hearing students as well as an all-girls coding club where we hope to connect girls from around the world.

Summary of Learnings from CoBuild19

Social media outlets provide a great mechanism to get the word out about opportunities and to get people to view content. With the rapid and substantial growth of our Facebook group and a large number of 'views' of the videos we created, we could argue some level of success in getting these activity ideas out to families in need. However, since we did not see strong evidence of participation from users in the form of responses, images, videos, etc., we do not feel these markers are a good proxy for engagement at home. Additionally, when we first started the CoBuild19 group, there was a lot of excitement and cross-sharing of ideas. However, at some point, this transitioned to be more top-down where there were a few people/groups posting content but little of it came from individuals. This dwindling and/or lack of participation could be the result of a variety of factors, including the type and format of content [4], perceived community support [5], and individual online behavior (e.g., posters vs. lurkers) [6].

For the number of different activities that we created, it seems that a pattern of participation emerged. When we initially announced an activity like a camp, there often was excitement that led to a certain number of initial people indicating interest. Then, when we asked for a more formal registration, we observed a drop in interest to about half of those from the initial group

who took steps to register. When it came to initial participation, the group was about half the size of those registered. Finally, by the end of the activity, the group had winnowed to half to ⅔ of the group that started the activity phase. For example, in our Camp CoBuild we had about 80 families show initial interest in the first camp, and 42 of those registered to participate. In our first session, there were about 20 kids/families which winnowed to about 14 kids who completed the activities across the camp. Similarly, in Design with Code, we had nearly 200 families register, 105 participate in the first session, and only about 40-50 kids/families in the final sessions. These general dynamics have held in a few other activities we have run. We think it is important for organizations to understand these types of enrollment and participation/attrition patterns as they are important when it comes to planning instruction and other logistics.

As 2020 progressed and the 2020-2021 school year began with many kids experiencing learning online, we saw evidence of concerns over extended screen time and "Zoom fatigue" [7-9]. Specifically, caregivers indicated an interest in our offerings but lamented that they felt they just could not have their kids sit in front of a screen for any more time that is required. We expect this issue eventually will be reduced, but we feel there may be some lag effect where for a few months there may be a residual hesitancy for caregivers to recommend online events for kids when there are offline alternatives.

Finally, one of the challenges we have been attempting to address since we began planning this study is how to overcome the challenges of getting materials to those kids that are most in need. We realized that Facebook is not used or accessible by all individuals across America, although it is used by a large majority [10]. However, there are demographic differences in who accesses the site and in what way they use it. Users of our Facebook group were primarily female in the 35-44-year-old age range. While we do not have a strong grasp on the socioeconomic profile of our CoBuild19 users, we suspect they are from middle- and upper-income settings. This may reflect only a select group of users that provide care or educational support to our target audience of children and families. We also realized that Facebook and parents serve as intermediaries as we try to get activities out to kids, and this presents challenges. Namely, we provided activities via Facebook, which children could not directly access to their age. As such, parents served as "gatekeepers", in that they would have to search for and find activities, only sharing those that they deemed appropriate or of interest to their children [11-12]. Parents' role as gatekeepers might have also impacted the level of participation on the Facebook group in terms of sharing of activities completed. Parents may have been hesitant to share pictures or videos of their children due to wanting to protect their privacy [13].

Additionally, we grappled with how we could get materials out to kids - what could we expect them to have and what they needed. Also, in what ways could they consume our content - what options were available and what their preferences were. A number of the collaborators on our team tried kit and material delivery with varying amounts of success. We also had conversations

with educators who said that after months of online learning they now realize that at least some percentage of their students do not have reliable internet and do not have ready access to tools and materials that we take for granted (e.g., scissors, paper, recyclables). Although we have not "solved" this issue, we decided to try to gather some data from potential users to understand more about what these families do have available and how they might connect to the information and activities that we've created. We plan to engage in a data collection effort over the next few weeks and should be able to report findings from this effort during the poster session.

Conclusions

We started this project to fill what we perceived as a developing, immediate need in the community. What we did not expect was how long the pandemic – and the need for online activities and support – would last. We were taking an approach to address this at a large scale (e.g., across the US) and with a team that consisted of members spanning many different organizations. Although we have not achieved the level of success we had hoped for, in other ways the effort achieved quick growth that took us in a different direction than we originally expected. Admittedly, we have focused on content production and curation more than on answering deep research questions, but as we have gained experience with this effort, we have been challenged as the needs of users have shifted over the course of the pandemic. In the long run, we feel that we created useful content that educators and families can use to engage kids with minimal materials and that we have a few models of extended engagement (e.g., DwCC, Camp CoBuild) that we can develop further into future offerings.

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