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# Case Study: LearningWorks Afterschool program in Waterboro, Maine

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MILLION GIRLS MOONSHOT

The Million Girls Moonshot is an Initiative of STEM Next Opportunity Fund.

# Watching a Virtual Afterschool Acvitity: Building Igloos

A gallery of small squares, four displaying the faces of children and two displaying the grayed-out silhouettes indicating someone with their camera off, form a line down the left side of the Zoom screen. In the center, Aimee Moody, Afterschool Director for the Waterboro, Maine location of LearningWorks is sharing a slide on learning from failure. It is the last of a four-session afterschool STEM program: Designing Igloos: Warm Homes for the Inuits, adapted from a Boston Science Museum curriculum for supporting the growth of an engineering mindset. Children must design an igloo using only the materials they were given, and it must accommodate, without folding or rolling, the provided paper photograph of an Inuit family. Moody's program is one component of a larger afterschool program, and due to time constraints, has broken the activity into four sessions: Session 1: Introduction, Sessions 2-3: Improve (create and revise), Session 4: Showcase (share and reflect). Moody asks the children if they have any thoughts they would like to contribute. Suddenly, one of the girls, who hasn't spoken previously and has kept her camera off for most of the sessions, chimes in, "Mrs. Moody, when [another girl] said mistakes, it reminded me that we can learn from mistakes." Later, the same girl contributes further to the activity by researching and reporting out on whether igloos may contain fire pits, an activity she was not asked to do, but chose to do without direction.

Moody's program was attended by four girls and two boys ranging from second to fifth grade. Over the four sessions, some of the girls went from being quiet and not turning on their cameras to enthusiastically participating, researching and sharing their discoveries without being prompted. Another girl found unique ways to use her materials. Throughout the activity Moody created ways to get all of the girls to actively participate in ways that felt authentic and unforced. How was this achieved in such a short time, and virtually? In order to understand this success, we explored some of the training Moody and other staff at LearningWorks have participated in, LearningWorks itself, and some of the behind-the-scenes decisions in planning and preparation that created an inclusive environment for girls in STEM. For this case study, Kate Kastelein, an MMSA research associate, observed and rated four pre-recorded afterschool sessions conducted by Aimee Moody using an adapted version of DoS protocol, and conducted interviews with Moody and LearningWorks Executive Director, Heather Davis.



Screenshot of students engaging in a "Find the STEM" activity using line drawing of an Inuit village Credit: Wikipedia Commons

#### **Preparation and Training**

LearningWorks was originally founded in the 1960s as an organization that focused on access to affordable housing. As time wore on, the organization grew and changed its focus to education, and in 2016 created a new mission statement: LearningWorks reimagines learning through innovative programs that help children, adults, and families realize their potential and build thriving communities. Each year, LearningWorks serves 3,000 individuals across 47 Maine towns, with their youth afterschool programs serving children in Pre-K through 5th grade. Instead of creating programs specifically for one gender, LearningWorks, which is a 21st Century Community Learning Center, works to create STEM programming that will appeal to all children. Girls make up about two thirds of Moody's afterschool STEM programs on a typical day.

Through extensive training and collaboration with local, state, and national organizations, Moody and other staff at LearningWorks have incorporated the practices they learned to form an inclusive environment for girls to participate in STEM, and specifically to help them adopt an engineering mindset. One such program is ACRES, offered by Maine Mathematics and Science Alliance. It provides virtual training opportunities for afterschool STEM educators, with a focus on developing STEM facilitation skills. ACRES has incorporated Million Girl Moonshot practices into some of its modules and offers one specifically in engineering design. Moody has participated in every ACRES module and her staff have all taken modules that focus on asking youth purposeful questions and giving youth voice and choice in their learning. Moody says of the training, "Those (facilitation skills) are two biggies that are our staples, when we're designing our STEM curriculum - we're constantly looking at how we can give students more opportunities to have their voices be heard, and ... to have it be student driven."

In addition to participating in trainings, Moody is also on the board of the Maine Afterschool Network STEM Advisory committee, which provides resources and networking for those working in Maine afterschool programming. The Maine Afterschool Network frequently distributes information and resources regarding the Million Girl Moonshot to its members, and Moody regularly models those practices for members. For example, she recently volunteered to lead Maine Afterschool Network participants through a paper plane building activity in order to demonstrate how to incorporate purposeful questions into virtual activities.

#### **Use of Transformative Practices**

LearningWorks does not create programming specifically for girls, but when creating and promoting afterschool sessions, Moody and staff at LearningWorks often look beyond common STEM terminology and examples to other components of the program that might be of interest to a wide range of students. For example, when discussing the initial introduction of the igloo project, Moody said, "I didn't start by telling my students that we're going to be measuring and we're going to be problem solving. I said, 'we're going to be creative, and we're going to get the opportunity to work with our hands and use our imaginations'."

Heather Davis, Executive Director at LearningWorks, gave an example of how one afterschool engineering program focused on creating a way to drop supplies into an area of Thailand hit by a natural disaster, and added additional learning opportunities to appeal to a wider audience:

The question is something like, how do you get supplies to these people, if you have to drop a lot of food and water and medicine and clothing into the middle of an area that you can't drive to? How are you going to do that? And so, they learn the engineering design process, to work collaboratively in teams to design that mechanism. And at the same time, they read stories, watch videos, do different kinds of work to learn things like where's Thailand? Can you find it on the globe? What do they eat there? Let's try Thai food today...it's a really exciting way to work with them.

The seamless and authentic way that Moody encourages girls to adopt an engineering mindset is not by chance; though her approach seems natural and informal, each lesson is carefully planned. Materials are chosen to ensure that women and girls are not depicted in stereotypical gender roles. For example, part of the igloo design challenge is to make the structure large enough so that a photograph of an Inuit family can fit inside. While the engineering task focuses on the qualities of the photo itself (size, stiffness, etc.), Moody used the opportunity to select a photo that would also show a balanced view of Inuit life. She explained, "It took my team quite a bit of time to figure out the right picture. Because we wanted to make sure it wasn't a picture of a boy holding a fish, and the girl was just looking cute. We wanted to make sure that the genders were really represented in equal roles."

Throughout the sessions we observed, Moody consistently and enthusiastically referred to the children as engineers, and what they were doing as engineering. Before the igloo building activities began, Moody spent a session introducing the group to STEM in everyday life. She shared a photograph of an SUV on a snowy road and asked the children to find the examples of STEM in the photo, spending extra time focusing on engineering as, "something that is invented by a person." One of the girls pointed out the guard rails, and Moody agreed, saying that they were definitely engineered. At the end, Moody remarked that they all "had their engineering caps on." This short session began to lay the groundwork for thinking about engineering in their lives, and also encouragement to think of themselves as engineers. Moody also asked the children to share examples of math, science, and technology suggested by the photo, and several offered creative ideas, such as "how strong are the guardrails?" (math and experimental science) "How far does the power go in the powerlines?" (technology), and "What elements make up a tree?" (biology.) She took time to ask similar questions about an image of an Inuit village in a subsequent lesson, so that students could develop an understanding of the similarities and differences among the four STEM fields.

engineer to college student. Also, LearningWorks involved community members through its use of returning middle school students to serve as mentors for the younger children. Specifically, Moody's program directly serves youth in 2nd-5th grades, but often previous participants return to help her with the younger children. The pandemic has presented challenges to the in-person programming, but Moody pointed out a few ways that the pivot has deepened her connection with youth, particularly in terms of family engagement. Previously, children would be picked up or ride a bus home at the end of an activity session, and there was little opportunity to meet with parents. Now, LearningWorks materials are dropped off at the homes of children by staff, often providing an opportunity for an informal, sociallydistanced meeting. Also, because the activities are now homebased, younger children often need help logging on to Zoom, so caregivers may be present in the room listening and sometimes helping with activities. Moody said that previously, on family nights held at the LearningWorks site, caregivers were sometimes intimidated to participate even in simple design activities that were set up, but they seem to be much more comfortable participating now that the activities are happening at home.



Pre-Covid Afterschool class Credit: LearningWorks

Prior to COVID-19, LearningWorks often invited community leaders, many of whom were women, to speak with youth. The speakers' careers ranged from boat captain and agriculture



Screenshot of participant virtually sharing her igloo progress with group Credit: Wikimedia Commons

## Challenges

Many challenges arise when trying to deliver equitable handson afterschool sessions, and LearningWorks has found some interesting solutions to many of these. Materials that would have been provided on-site are now delivered bi-weekly to the children's homes, which is greatly appreciated but takes considerable time for staff. For the igloo activity the children received a package that included markers, notecards, masking tape, cotton balls, the photograph of an Inuit family, solo cups in various colors, and even snacks. While this solved the problem of access to materials, we observed that it still took time during the session for children to locate their materials, sometimes needing to leave the room or consult with an adult or sibling about where their materials were. Engineering activities often include an in-depth planning stage, as was the case with the igloo activity, and although Moody explained what they needed to plan and why, many children were eager to skip that part and began working with their materials before the planning stage was complete. The powerful appeal that hands-on materials have for youth may have been particularly strong in an otherwise hands-off virtual environment.



Intuit family photo used for igloo project Credit: Wikimedia Commons

Another difficulty that arises with virtual instruction is the option for youth to turn off their cameras. Although Moody encouraged everyone to have their cameras on, some youth kept them off. To keep participation equitable, Moody gave each child the opportunity to respond to questions and participate in planning, even if their camera was off, and gave them the option to type in the chat if they were uncomfortable speaking. In the end, every child contributed to the discussion in one way or another.

There was often substantial introduction and planning during each session, which, although valuable, seemed to detract from the "fun" factor for young participants. At the beginning of session two, a girl asked if they were going to start building, and when Moody explained they would be planning, the girl responded, "Oh! But I wanted to build!" Another girl agreed that she too wanted to start building. Youth, though eager to start the hands-on portion of the program, only rarely had enough time to complete their projects. Children were encouraged to work on their igloos during their own time, and a few did, but none completed the project. This time crunch may have been largely due to the sessions being only 30 mins (allowing time for other non-STEM program activities) but may have been exacerbated by the virtual nature of the activity and the extra time required for the children to find all their materials and be oriented to the project. There was also too little time for children to complete an online evaluation.

## **Characterizing Youth Learning**

Most of the girls in the afterschool igloo building session led by Moody consistently shared their ideas and contributed to the discussion. For the final session, the children planned to share and give each other feedback on their creations. Prior to the sharing, Moody talked to them about failure, learning from failure, and reiterated that most engineers have to try their designs many times. She also introduced the practice of "glow and grow" when giving feedback. Youth were given examples of glowing feedback: "I really like how you position the window," as well as growing feedback: "Maybe next time the entrance could be taller." Moody volunteered to go first, so that the youth would have an opportunity to critique her work as well. One of the girls shared her igloo and explained that she had taped the notecards to the floor and also used the solo cups to bend cards and create more of a circular shape. Moody complimented her on thinking creatively in using the solo cups and using the floor as a base for her creation.

Though it may be difficult to measure engineering mindset changes or career aspirations with elementary aged children that LearningWorks serves, both Davis and Moody said that they have seen changes in girls related to their willingness to speak up, participate, and even take on leadership roles. Davis said:

A lot of what we see, especially with girls, is a growth in engagement and leadership. This summer, in our "Agricultural Engineering" unit in South Portland, we had a girl who was a little bit shy at first. And then when she started working with the teachers, and they started helping her identify herself as a scientific thinker.... she wanted more and more of that. So, she wanted to take on leadership in the group and lead different activities and take notes for the teachers and started being more vocal in the classes. We just had a student in our Portland "Sound Engineering" program, who also has shown the same thing – it took about two months for her to warm up, and now she's really interested in taking on that leadership role. I think what it's doing, where we see the biggest increases with all students, but definitely with girls, is around the confidence in the engagement. They might start out – and we get confirmation from this from the school day teachers – they might not be raising their hands, their attendance might be a little spotty, they might not be doing their homework. But what's happening is they start to identify themselves as someone who enjoys school, connects with school, and connects with the material because of this engagement in STEM programming.

Davis said that building skills such as speaking up and finding enjoyment in STEM at such a young age (4-10) can be transformative for children.

As part of the case study, a member of the MMSA research team created and deployed an experimental adaptation of the DoS (Dimension of Success) observation protocol to measure the Engineering Mindset best practices recommended by STEM Next and the Million Girl Moonshot. As with the original DoS protocol, these observations attempted to evaluate the program quality, not the participants. If we had used the 12 dimensions of the original DoS protocol, Moody's lessons would have received low ratings as they did not focus on science content or inquiry. Although there was some instruction on all four STEM fields, the primary content and hands-on activity involved understanding the technology and engineering of igloos. The science phenomenon of melting was brought up by the children during the lesson, as it related to the need for the Inuit family to stay warm and cook inside a structure built of snow. Although that was as important contribution to the lesson, which Moody encouraged, it would not have been sufficient to provide a high rating for that lesson.

Therefore, our team modified the DoS protocol by defining 15 dimensions, ranging from organization to creativity to inquiry, that were rated using a rubric where a score of 1 indicated that little to none of the practice was observed, and 4 indicated exemplary use of the recommended practice.

The average rating across all dimensions for all four sessions was 3.4, indicating that engineering mindset practices were observed being utilized most of the time. Because the activity was broken into four sessions, with the first being an introduction to STEM in general and the last including time to finish building, share, and reflect, the overall average rating for each session grew from a mid-range of 2.7 to a high of 3.8 for the last session. Several individual practices received the maximum rating of 4 across all four sessions, including organization, materials, and engagement with STEM. STEM identity was another area that consistently received high ratings due to Moody's consistent message that the youth were thinking like engineers and that the activity was engineering. From the ratings we were able to conclude that LearningWorks was able to provide programming consistent with principles for an engineering mindset as established by Million Girl Moonshot. Though some of the early sessions were lacking in a few of the areas, the sessions built upon each other to form a complete set of engineering mindset practices by the end.





Figure above demonstrates the average for dimensions, 3.4. Dimensions defined by team ranging from organization to creativity to inquiry.

LearningWorks has been able to continue to provide equitable and inspiring engineering opportunities for girls virtually during COVID-19, due in large part to their existing pre-COVID systems and training. Their success reflects thoughtful planning and an eye towards equity from the very beginning – presenting the program to girls in a way that is inclusive and interesting to encourage participation. With the support of training and networking through ACRES, Maine Afterschool Network, and Million Girl Moonshot, afterschool leaders like Aimee Moody and executive directors like Heather Davis have created multi-layered systems to support engineering mindset and robust STEM pathways for the girls in their communities.

#### Data visualization by session

Average Ratings by Session



Session 1 Ratings by Dimension



Session 3 Ratings by Dimension



Session 2 Ratings by Dimension



Session 4 Ratings by Dimension



Dimension