An Unexpected Outcome

Afterschool STEM Enrichment Empowers Facilitators, Too!

Michelle Masarik

One of the goals of afterschool programming is to empower students by increasing their sense of autonomy and giving them room to chart their own course of discovery.

Long before STEM (science, technology, engineering, and math) became part of the educational vernacular, afterschool practitioners were using science content and scientific practices as tools for youth empowerment. For that empowerment to happen, the youth themselves have to connect to the content and experience self-actualization.

During my time as an outdoor program specialist and camp director for the Girl Scouts, I designed and taught programs that exposed girls to science. I quickly discovered my own personal enthusiasm for the STEM experiences that are abundant in everyday life, along with a willingness to share my enthusiasm. But I was a mom with two daughters and no college degree. I didn't think of what I was doing as a real contribution to STEM education or to girls' empowerment. However, as I continued to design programs to encourage girls in STEM, I

discovered that I was also being encouraged. As I taught girls to reach for more, I also became something more.

Using that background and my increasing self-efficacy, I continued to work in afterschool STEM enrichment. In my work with middle-school-aged youth in a 21st Century Community Learning Centers program, I've found that robust STEM experiences can empower not only program participants but also their facilitators.

Empowerment, defined as the capacity for self-determination, is important to every person's well-being; the term is often used in discussions of program design and education. Self-determination includes the need for autonomy, the competence to express individual talent and skills, and the ability to overcome the fear of failure (Ryan & Deci, 2000).

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STEM enrichment gives young people the means to acquire knowledge, realize their abilities, and practice their skills in a consequence-free environment. These activities in turn enhance development of metacognitive skills—the ability to be aware of one's own mental process. For example, middle school students begin to use strategies for learning and knowing when it is appropriate to apply them (Broderick & Blewitt, 2010). In practicing and developing these skills, students can experience increased empowerment in at least three areas: identity, communication, and critical thinking.

In addition, STEM enrichment uses inquiry and scientific method to develop self-efficacy—both in learners and in educators. To successfully facilitate STEM learning, educators need to learn the content and, more importantly, the methods that increase learners' interest and excitement (Ejiwale, 2012). As educators work to increase their skills and knowledge to present the best experience for their students, an unexpected outcome can be an increase in their own self-efficacy and STEM identity.

Empowering Identity

Middle school students are poised to leave behind the identities their families and social institutions have conferred upon them so they can construct their own personae (Broderick & Blewitt, 2010). If you ask middle school youth what they want to be when they grow up, their answers will change regularly. Erikson (1968) noted that adolescent identity is not something that is attained; it is constantly reassessed and reframed according to realized abilities and personal goals. The child who lives, eats, and breathes dinosaurs today could have a bedroom decorated with planets and astronauts just a year later. Early adolescents need to feel that they can explore their interests—and change their minds daily if they want. STEM programming gives young people the chance to explore new ideas, new skills, and new selves through elements that help adolescent identity development such as small-group activities, supportive adults, and lesson plans that value experimentation and critical thinking (Elkind,1984).

Exposure to STEM activities can help develop adolescent identity in at least two ways. First, STEM gives students the opportunity to "try on new hats." They can, for example, experience how engineers work by designing and building a structure from toothpicks and marshmallows or see for themselves what it's like to be a computer programmer by learning to code. When I teach coding to fourth-graders in my afterschool program, I remind them that they are now computer programmers. They have learned Boolean logic, conditional statements, and other concepts that I didn't learn until my college computer class. For some students, exploration of topics in this way can lead to development of committed STEM identities. Whatever career identity middle schoolers choose is likely to change! But at least STEM has been part of their ongoing exploration, facilitated by hands-on experiences that are better aligned with actual careers than whatever they might learn from textbooks or movies.

Second, STEM activities can also help some students who struggle in other areas to develop identities as competent learners. One of my fourth-graders, whom I'll call Liam, was classified as high-functioning autistic. During our computer coding course, he had the chance to interact with his classmates in new ways. It helped that the informal environment was accepting of Liam's need to move around and his tendency to shout out answers. However, the shifts in dynamics in the group were what made this program special. Liam proved to be adroit at conditional statements like "If raining, bring umbrella = TRUE." He therefore could take on the role of helper with his peers. During the school day, other students helped Liam with his social skills, reminding him, for example, not to talk out of turn. Now Liam was able to help his peers with their coding skills.

Empowering Communication

Young people involved in STEM enrichment learn to speak STEM language. Many aspects of STEM language, including math notation and technology terms like *laser* and *microchip*, are nearly universal; they are the same in all languages. Students bond over STEM learning as they learn a language that transcends geographical borders and cultural differences.

In order to capitalize on STEM language, my program has chosen to label some of our STEM enrichment programs "clubs." Being part of a science or engineering "club" adds a level of ownership because students have chosen this enrichment activity. The club also shares the language of its topic. I have overheard students proudly discussing the various types of gulls perched on the school roof or the names and needs of the new plants their gardening club installed. Students use their new language both in talking to other club members and in explaining what they do to other students.

The low-income communities in which most of my out-of-school time work takes place have seen an influx of immigration. Many of the students come from homes where the adults speak little or no English. These students may struggle with literary-based subjects, but they can shine in hands-on STEM activities. When they grow

plants, solve equations, create video games, or mix chemicals, the results are the same no matter what language they speak at home or where their family is from. They can also share these hands-on experiences and concrete results with their parents in their own languages more easily than they can share more abstract learning.

I've found that my immigrant students are less likely to complain about math than children in monolingual households. During homework help time, I noticed that some students routinely left a few math problems blank. When I asked if they needed help, they replied that they had left these problems blank so that they could do them in front of their parents to show how well they are doing. Math is one area immigrant students can share easily with their parents.

Empowering Critical Thinking

Critical thinking is the foundation of STEM programming. Afterschool STEM facilitators develop learners' critical thinking skills by helping them use the scientific method and showing them basic research methods. They set up challenges and then quietly guide learners through the process of problem solving: identifying the problem, deciding how to resolve the problem, setting and testing a hypothesis, observing the results, and beginning the process again as needed. STEM activities teach young people to break challenges into smaller chunks rather than being overwhelmed.

In my own STEM facilitation, I put fourth graders into teams to investigate problems. For example, one project is to create a bird nest that protects eggs from predators. I let the teams work on their own but keep track of their progress by visiting each team in turn. As I do, I ask open-ended questions: "Why did you choose this material to build your nest?" "Could the entrance be changed to protect the eggs?" This practice allows the learners to be the experts. I will ask students to stop, put down their materials, and come together to discuss what they are doing. "Is your nest working the way you think it should? No? What do you think is happening?" Questions spur team members to dissect their design to discover any flaws. Though there is a challenge to be met, *how* the students arrive at the solution is more important than finding the answer. The critical thinking process they learn will carry on to other programs and future activities.

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Empowerment Through Self-Efficacy

In addition to helping young people develop their identity, their ability to communicate, and their critical thinking skills, STEM activities can empower young people by helping them develop self-efficacy. Self-efficacy is the belief that one has the ability to succeed, whether at a current task or in broader societal settings (Bandura, 2012). High-quality STEM programming is designed to empower self-efficacy as scaffolded activities build on one another, using skills mastered at one level to launch the next. As learners complete each task and meet each challenge, they build self-efficacy.

One of my favorite examples of a program that scaffolds learning to build self-efficacy is the Design It! series offered by 4-H and Rutgers University. I use the program to introduce incoming fourth-graders to the mindset that STEM does not consist of "one and done" activities. Each module has five to seven activities that build on skills mastered in sequence. One of my students' favorite modules is Tracks and Balls, in which learners use insulation tubing, marbles, and copious amounts of tape to build structures that simulate rollercoasters. In the first week's assignment, building a ski jump, teams learn how to adjust height, angle, and momentum to make a marble jump the longest distance. The skills and teamwork they learn in this activity help them tackle more complex challenges in the weeks to come, such as hills and valleys where the students are challenged to see how long their marble stays on the track. In the first weeks, I give teams a fair amount of guidance, prompting them, for example, to stop and observe what is happening and to fix one issue at a time; I repeat the ever-popular mantra, "Test before you tape." As the weeks go on, however, the learners take over this role. They begin to guide themselves and each other with reminders to slow down, test, observe, and reassess.

In programs like Design It!, students learn STEM terms and content; more importantly, their self-efficacy increases as they work together to solve problems. My task is to make sure that every voice is heard and that no student is left out of the problem-solving process. With guidance, students begin to understand that the process itself makes them scientists. That belief curbs frustration, increases perseverance, and raises self-efficacy, which in turn empowers students to be an active part of the afterschool community.

I have seen the attitude of our students evolve from our first year to now. At first, when we asked participants what courses they would like added to the program, they could not imagine what to say. Now, they look forward to their next enrichment choices; many are eager to join the student council in order to present new ideas for classes. This self-efficacy is, for me, the largest accomplishment of our afterschool STEM enrichment program

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Afterschool practitioners often say that they get just as much out of facilitating activities as the learners get out of participating. Working with a STEM agenda brings new life to the phrase. Beyond enjoying the activities, practitioners also gain valuable, marketable skills by facilitating STEM programming. Certainly that was my experience.

Though some afterschool STEM instructors are industry professionals or school-day STEM teachers, many are like me—people from outside the field who enjoy a challenge and are willing to learn something new in order to improve young people's experiences. My experience shows that the only things such instructors need are a positive attitude, enthusiasm, and the desire to gain knowledge and acquire new skills. STEM training is available for those who want it. No academic credentials are required to take, for example, workshops on computer programming from coding.org, on engineering from Design It!, or on robotics from Lego or Vexx.

As I became more adept at facilitating STEM programming, I began to believe that I was all the things that I was asking my students to believe they could be. Together, we were all becoming scientists, engineers, and computer programmers. Both my students and I had a voice, a point of view, and a place at the proverbial table.

I have now been providing afterschool STEM enrichment for more than six years. After being offered training, I found myself included in decision making and exposed to industry leaders and state policy makers. I was not just facilitating afterschool programming; I was involved in a movement.

But my personal identity was out of alignment with how others were viewing me. The first time another instructor asked if I was a science teacher, I was a little shocked. Didn't she see the large sign on my forehead, "Mom without a degree"? I cared deeply about STEM and about the students, but I did not look beyond my self-appointed role as a support person. However, with each successful program, each person who asked for help with STEM programing, my identity evolved. An afterschool STEM trainer asked for my help with a project, saying that

I was an expert in my field. A local foundation asked me to serve as its STEM advisor. Clearly the people I worked with saw something in me that I did not see in myself.

Finally, I was asked to apply for an open position in a 21st Century Community Learning Centers program. I was flattered, but I didn't have the educational credentials to apply. The self-efficacy I had developed in the course of running, researching, and developing STEM programs came to the rescue. It gave me faith in myself so that I completed my BS and earned an MS degree in less than two and a half years. I felt empowered to finish my education because I had become part of the STEM afterschool enrichment movement. All the time I had been using STEM activities to encourage self-efficacy and empowerment in students, I had also developed my own self-efficacy and empowered myself to reach for my dreams with courage and conviction.

I am not unique. As I visit other afterschool sites to run programs or to train or collaborate with colleagues, I interact with many afterschool practitioners who have similar backgrounds. They may be retired teachers who miss interacting with students, young adults who are trying to decide their next step, or women whose children are now in school and are not sure where they have a place. Working in STEM enrichment changed how I see myself and empowered me to make the changes necessary to become that person. Now it is time to pay it forward, reaching out to others so they can realize their own self-efficacy and identify themselves as the experts they are.

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