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Students at the Tech Center for Baltimore's Digital Harbor Foundation. | Mark Peterson/Redux Pictures for Politico Magazine

WHAT WORKS

How Baltimore Is Growing Its Tech Gurus From Scratch

In Baltimore, an inventive nonprofit is teaching children from the inner city the skills they need to get good jobs in their hometown.

By ERICK TRICKEY | October 19, 2017

BALTIMORE — Zion Greene and Damion Saunders are building a robot out of Crayola markers, a plastic cup, a DC motor and a piece of foam pool noodle. “What if we made a chain belt, like chains on a bike?” asks Zion, 14, as he threads a rubber band around the motor’s tiny bit.

In a vast room inside a former recreation center, 25 middle school and high school kids are tinkering, testing and inventing. At five tables, kids try to build artbots, three-legged machines designed to move and leave marks on paper. Across the room, kids are sticking red, yellow and green LED lights into circuit boards, then typing code into laptops to make them turn on. Nearby, a 3D printer darts to and fro with a white-noise *shhhh*, emitting a faint odor of burning plastic as it produces a yellow pendant etched with a honeycomb pattern.

It's late afternoon and kids from Baltimore and beyond are gathered for after-school courses at the Digital Harbor Foundation, a nonprofit laboratory that has a serious mission to inspire children living in the city's core to play with technology as eagerly as they do video games. In the middle of the room, Shawn Grimes, the 37-year-old executive director of Digital Harbor, stands up his own artbot: a foam noodle-topped cup that vibrates on three pencil legs. Damion, 11, watches from the next table. "Let's re-create that," Damion says to his partner, reaching for some pencils.

"Not re-create, but better," Zion replies.

Five years ago, Digital Harbor turned a shuttered Baltimore rec center into a vibrant tech center and now regularly draws dozens of kids a week to take courses that promote STEM education—the much-coveted package of science, technology, engineering and mathematics skills—without making it sound like work. That's the idea behind "maker education," a movement that promotes a 21st-century version of learning by doing. Maker spaces for kids have started up around the country in the past decade, teaching tech-savvy, project-based lessons, including 3D printing, and website, game and app design, to the post-millennial generation.

"I feel like this is how school should be," says Quan'taz Smith, 16, a high school junior from West Baltimore. He has taken four courses in eight months and is now enrolled in a 14-week course on programming for Arduino, a software-and-circuit-board computer platform, and a college-credit course in

digital fabrication. It's a first step toward his goal to major in industrial engineering in college. "Learning here is much easier," Smith says. "You don't feel like you're learning, because you're having fun."

Since Digital Harbor's 2012 founding, its take on maker education has attracted high-level attention in nearby Washington. In 2014, President Barack Obama launched the Nation of Makers initiative, to encourage maker education and maker spaces as training grounds and laboratories for next-generation jobs and technology. Digital Harbor kids have participated in the annual White House science fair, a kids' panel of presidential science advisers, and last year's South by South Lawn music and tech festival on the White House grounds. In 2015, Digital Harbor's founder, a former Mormon missionary turned high school teacher named Andrew Coy, joined the Obama administration as a senior adviser overseeing the Nation of Makers initiative. Now, Coy, 32, consults for the initiative's nonprofit successor of the same name.

"If we [want to] anticipate the next major economic driver, like the Internet or personal computing, we need to be investing in folks who are thinking differently, and prototyping, and coming up with this stuff," Coy says. "You can't be a constant expert in technology -- it's moving too fast, there's too much going on -- so what you have to be is an expert in learning."

Digital Harbor, too, is spreading the word about making. "One thing Digital Harbor does quite well is using its space to engage educators themselves," says Dorothy Jones-Davis, executive director of Nation of Makers. Digital Harbor's instructors, mostly millennials, have taught teachers in several states and across Maryland how to get their kids to learn by doing. "It's really become a model for a lot of other spaces around the country," says Jones-Davis, "in terms of the way they develop their programming to get both educators and students trained up in how to make."

While Digital Harbor is helping to spread maker education across the country through professional development, its biggest challenge is right in its

backyard, addressing Baltimore's poverty and the shortage of opportunity for young people of color, even in a state that is recognized as a leader in the nation for the share of high-tech jobs in its economy.

In Baltimore, a city of 620,000 in which 35 percent of children were living in poverty, and 37 percent of black men aged 20 to 24 were unemployed as of 2013, those jobs can seem out of reach. Most Digital Harbor kids are students of color, and girls make up about 40 percent of the program. That's very different from the nation's STEM workforce and education pipeline. Black and Hispanic students are still less likely to attend college and graduate than whites or Asians, though when they do, they choose STEM degrees about as often as whites. Women make up only about 25 percent of the nation's STEM workforce, and black and Hispanic workers combined make up only about 12 percent of it. Aware of the financial barriers for poor children, Digital Harbor's programs are pay-what-you-can—many youths pay nothing to attend—and the staff focuses recruitment on city kids in poor neighborhoods.

The nonprofit is also providing teens with paying jobs now: An in-house 3D printing shop staffed by teens makes plastic models for paying clients. Researchers have found that Digital Harbor's after-school program boosts the kids' creativity and tenacity, but the path to employment is just as important.

“Creativity is evenly distributed, but opportunity is not,” says Coy, who started Digital Harbor when he was a 24-year-old high school teacher and is now its chairman of the board. “I'd tell stories about startups in garages and dorm rooms. And I realized, these kids live in row homes. They don't have a garage. So many of them don't make it to dorm rooms. They still have ideas and passion, but they need a space, like a rec center, to go to and develop that.”

Eight years ago, Coy, a restless, tech-savvy millennial with a short-cropped beard, brown hair and glasses, enrolled in Teach for America, which sent him to teach history and American government at Digital Harbor High School in

Baltimore's historic Federal Hill neighborhood. "I lived in these two worlds," says Coy, who grew up in Alaska and graduated from Brigham Young University. "I would go to tech events, where it was mostly 20- to 40-year-old white guys." Meanwhile, students of color filled his classrooms. One day, teaching the kids about the Supreme Court's 1954 *Brown v Board of Education* decision, he stopped in midsentence, hyperaware of the contrast. "I thought, I'm the only white person in this room," he recalls. Though *Brown* had struck down official segregation in schools, *de facto* segregation had survived. "The kids have ideas, have creativity, have drive, but oftentimes are missing that bridge to connect them into that world."

To bridge the gap, Coy embraced the school's focus on technology, founding an after-school club for WordPress website development that attracted about 20 kids. He persuaded small-budget nonprofits to hire some of the students to build their websites. Meanwhile, he took the students to tech events across Baltimore. Between his first and third years of teaching, Coy moved from teaching social studies to teaching an introduction to technology. As he looked for ways to prepare his students for jobs, his interest in maker education grew.

"Without context, kids are always going to ask, 'When am I ever going to use this? Why does this matter?'" Coy says. "But the moment you focus them on a real problem, and say, 'These are all the things you need to know to solve that problem,' all of sudden, they're learning and not even thinking about it."

In 2011, Coy helped organize an education hackathon, where local developers and designers built apps based on ideas from teachers and administrators. There, he befriended Sean Lane, an entrepreneur, former Air Force captain, and CEO of a Maryland-based defense contracting startup. Lane soon approached Coy with an idea. The city of Baltimore had closed down several of its recreation centers, including one a few blocks from Coy's school, as part of a plan to modernize and consolidate its recreation funding. Lane asked Coy what he'd do with the space. "I told him immediately: I'd turn it into a tech center," Coy recalls. Lane, who now runs a company in Ohio, had just

incorporated a nonprofit, the Digital Harbor Foundation, intending to offer scholarships to students at Coy's school. Instead, Lane offered it as a vehicle to fund Coy's idea of turning the old rec center into a maker space—a launch that cost about \$100,000.

To help build out the program, Coy hired Shawn and Steph Grimes, a couple he'd gotten to know at Baltimore tech events, where the three were usually the only adults who had brought students with them. Steph, a former kindergarten teacher, and Shawn, an app developer, had met in church during middle school and gone to high school together in suburban Dundalk. They reconnected at 27, after Steph was widowed and Shawn divorced. She'd left teaching to work with him on his apps, and they'd started an app-development club at their old high school.

The Digital Harbor Foundation's launch year was filled with trial, error and improvisation. The old rec center on Light Street in Federal Hill was built in the 1970s, with a brick exterior and cinder-block walls. As the staff moved borrowed and donated tech gadgets into its old meeting room, Coy, drawing on his Mormon missionary experience, invited teens he encountered on the street to come in and check out the space. At first, the staff encouraged the kids to tackle projects in a spirit of freeform experimentation, but some students drifted away, finding the program too unstructured.

The Grimeses adapted Coy's idea of a Web development club into STEM Engine, a short-lived venture that paid a few kids who already had Web-design skills to build websites for clients. But it stalled after about six months, as the first round of kids moved on to focus on school, and other kids didn't have the skills to replace them. In 2013, Digital Harbor shut down STEM Engine, and Coy made Shawn the director of technology and Steph the director of education and put them in charge of developing an after-school curriculum for kids.

Now, about 300 kids a year come to Digital Harbor after school from 4 to 6 p.m., twice a week, for 14-week courses. An elementary school program

teaches young kids the basics of design thinking: designing bookmarks with the free photo editor GIMP one day, drawing mandalas on another. A foundations course introduces middle school and high school kids to maker education through exercises such as constructing artbots. After their first semester, kids can sign up for advanced classes that include 3D printing, game programming and graphic design.

Researchers who've studied Digital Harbor kids recently found that teens who've gone through its introductory course show a 10-percent increase in "divergent thinking" – a measure of creativity – compared with kids just starting the intro course. A second evaluation tool showed that the kids who finished the introductory class showed a higher persistence of effort. It also found that their consistency of interest went down, a finding that fits maker education's goal of encouraging kids to try a lot of things and discover their interests.

The nonprofit also holds two-week summer camps for about 220 kids, weekend hackathons and family "make nights" for kids and their parents. Field trips by Baltimore-area schoolkids expose them to possible futures in tech and help recruit new enrollees. Digital Harbor's annual budget has grown to \$750,000, and it employs a staff of 14. Its major funders include Northrop Grumman, the defense contractor (which bases its high-tech Mission Systems division in suburban Baltimore), and the Maryland-based Harry and Jeanette Weinberg Foundation, which has given Digital Harbor seven grants totaling \$350,000 since 2014.

"They've done a really outstanding job of reaching out to girls and young people of all different races," says Sheryl Goldstein, the Weinberg Foundation's managing director of programs and grants. "They've engaged them in STEM in a way you don't typically see."

Girls make up about 35 to 49 percent of the kids in Digital Harbor's courses, says Shawn Grimes. About 60 to 70 percent of the kids are youth of color, and 65 to 75 percent are youth of need, in or near poverty. "We focus our

recruitment on underserved populations,” Grimes says. “We tend not to advertise or recruit in private schools or affluent neighborhoods, not because we don’t want [those kids], but they find out about it naturally.”

The tech sector, says Grimes, is Baltimore’s best opportunity for kids to make a living wage, even if they don’t go on to college. “We have a large number of unfilled tech jobs here,” Grimes says. “We’ve got a relatively good tech ecosystem – a lot of tech meetups and tech events going on.” Baltimore has plenty of tech companies, large and small, and plenty of government contractors around nearby Washington. Corporate donors to Digital Harbor, such as Northrop Grumman, tell Grimes they see the foundation’s work as a way to grow their talent pipeline. Digital Harbor’s courses prepare kids for entry-level jobs in software development, website development, graphic design, computer-controlled manufacturing and robotics in Maryland’s Amazon warehouses, says Grimes. They could also be a first step toward jobs in cybersecurity, a prominent economic sector in Maryland because of the many federal government agencies based in Maryland and Washington.

Digital Harbor’s broader goal, he says, is to do its part to address Baltimore’s deepest problems: poverty and a lack of opportunity in many neighborhoods. The mission became more urgent in April 2015, when riots after Freddie Gray’s death in Baltimore police custody led to 550 arrests, injuries to 150 police officers and \$9 million in damage to about 300 businesses, mostly in Northeast Baltimore, about four miles from Digital Harbor’s building in Federal Hill.

“When we had the civil unrest two years ago,” says Grimes, “a lot of us looked at it and saw [that] people who see a future for themselves do not do these things. It’s people who don’t have any fear of losing what’s ahead of them -- they’re OK doing crime, because if they end up in prison, they didn’t have any big plans anyway. Other people [think], ‘That might screw up my chances of getting into college. That might screw up my chances of getting a job.’”

Jacob Leggette is 10 years old, but he's already been to the White House twice. Last year, he met President Obama at the White House Science Fair. "We 3D-printed bubble wands," Jacob says.

Like any Washington operator, Jacob knows how to make the most of his moment with power. After they blew bubbles together, Jacob asked Obama if he had a kids' science advisory board. No, the president replied, but it'd be a good idea. "Later that year, they invited me and my sister back to the White House for the kids' science committee meeting," Jacob says. The administration debuted a website for the project soon after. "Ten thousand kids submitted their ideas for what they wanted to learn in science."

Today, Jacob has arrived at Digital Harbor's after-school program wearing a blue T-shirt emblazoned with the images of a circuit board in the shape of Baltimore's city limits. It's from last year's Baltimore Innovation Week, where Jacob won the youth STEM leader of the year award, beating out three adults who run youth programs. Jacob intends to build on his early successes: He wants to create artificial organs for his sister, an aspiring surgeon, to implant in patients.

Digital Harbor attracts brainy kids with interests in science, computers, engineering, art or design. "You get kids who are committed and have drive," Shawn Grimes says. "They're invested in themselves, but don't necessarily have opportunity to explore and expand on that." Their personalities differ widely, from the preternaturally ambitious to the socially anxious. But either way, the nonprofit's focus on requiring students to document and present their work helps them hone their communication skills.

When Sierra Seabrease's mother nudged her to start going to Digital Harbor in 2013, she was a high school freshman interested in photography. "I found my love of technology through them," says Sierra. Now a freshman at the University of Maryland, College Park, she's already chosen mechanical engineering as her major. In three years of after-school programs at Digital

Harbor, she learned to solder, program Arduinos and design websites—and kept going.

Sierra also converted an old piano into a jukebox, making 10 of its keys into buttons, numbered 0 to 9, and connecting them to a 100-song Spotify playlist. Randy Newman's "You've Got a Friend in Me," from the *Toy Story* soundtrack, was a favorite. So was Semisonic's "Closing Time," which Sierra would play at 6 p.m., as Digital Harbor's after-school program ended. She presented her piano at the 2015 White House Science Fair. "I have a lot more communication skills than I normally would," she says. "I'm fine with that now because I presented my piano so much." That year, she also presented a TED talk on gender inequality at an event for Baltimore youth. She also designed the foundation's website.

At Digital Harbor, Sierra founded the Makerettes, a club for girls. "We didn't really have a problem with getting girls there. We had a problem keeping girls there," she says. The Makerettes now meet on Fridays to work together on special projects.

Already, says Sierra, 18, her Digital Harbor experience is helping her in college. She's familiar with many of the issues in her ethics of engineering class. "It's really cool to see the parallels because I know a lot about the tech industry from the foundation," she says. In her women's studies class, "I have to talk a lot, and present a lot," she says, "but that was taught to me through DHF indirectly. It's been really helpful."

As a senior, Sierra interned at Fearless Solutions, a Baltimore software firm. Delali Dzirasa, Fearless' president, says the four Digital Harbor interns who've worked on software testing there have matched or surpassed college freshmen interns. Digital Harbor is preparing them well for the job market, Dzirasa says. "They've got the technical foundation as well as the ability to interact with people," he says.

"One of the first times I went to DHF, for a showcase, a kid was talking to me about a website he'd built," says Dzirasa. "He said, 'Here's my business card.

Shoot me an email.’ It wasn’t an anomaly. Kid after kid after kid was very articulate with what they did.”

Dzirasa enrolled his oldest son, Dominic, in Digital Harbor’s after-school programs when he was in middle school. Now 15, he’s ahead of his high school peers in STEM knowledge thanks to Digital Harbor. “He said he was bored in his computer science class—‘I already know how to do this,’” his dad says.

Darius McCoy, 20, works in a corner, surrounded by plastic models he has helped create: 15 blue rocket ships the shape and size of eggs, five Easter Island statues about 4 inches tall (one green, one orange, one tan and two blue), one Tyrannosaurus Rex skull the size of a dog’s head, and nine statues of Martin Luther, wearing a thick priestly robe, his hand on the Bible. The rockets, statues and T. rex are demonstration models, meant to show clients and new students what Digital Harbor’s 3D printing shop can do. The Martin Luthers are made for a client. This Halloween is the 500th anniversary of the Protestant Reformation, the day Luther nailed his 95 Theses to the church door in Wittenberg, Germany. So a Lutheran minister in Federal Hill has ordered the Luthers, which range from a couple of inches tall to more than a foot high but are otherwise identical.

It’s McCoy’s job to make sure the Martin Luthers are made and delivered on time and faithful to their specs. And it’s his job to make sure his paid staffers—all high school students—arrive on time, document their progress and stay productive. He is, in other words, teaching them the Protestant work ethic.

McCoy, a big, quiet guy wearing thick glasses, started coming to the Digital Harbor Foundation when he was a sophomore at Digital Harbor High School down the street. It was the foundation’s very early days, when there wasn’t a structured program yet. “At first it was a safe place to come, do homework and learn how to do websites,” he says. Before that, he says, he was staying home, playing video games—sports games and *Call of Duty*. Instead, Shawn

Grimes introduced him to 3D printing, and he learned programming and coding. He started a small business making iPhone cases. He also custom-built 3D printers, which he showed off at the White House Maker Faire in 2014.

In January, armed with a \$300,000 grant from the National Science Foundation, Digital Harbor opened its own 3D print shop, hired high school kids to run it, and put McCoy in charge. It's a return to one of the original ideas behind Digital Harbor: Not just to prepare teens for future jobs, but to hire them to do work right away. Researchers from the University of Maryland, Baltimore County are conducting a two-year study of the program's impact on how the youth perceive making, design and STEM careers.

The program pushes both the staff and McCoy. "It's taught me to be a manager," McCoy says quietly. "It's hard sometimes. I'm not too big on communicating [about] a lot of things, and I'd say the same for my staff." An introvert managing fellow introverts, McCoy says he's learning how to correct and criticize his employees without discouraging them.

Steph Grimes, the education director, says Digital Harbor is moving back to onsite job programs to react to the economic pressures on Baltimore teens. "Historically, we've lost a lot of high schoolers to jobs," she says. "In Baltimore, it's a very real fact that a lot of our youth have to contribute to their family as soon as they're able to." Those decisions come early: 14 is the minimum age for working in Maryland. Other kids choose drug dealing over legitimate employment. So Digital Harbor is striving to get kids to start their program in middle school, to give them plenty of time to develop job skills. That way, by high school, they'll be ready to use those skills in paid internships and work at Digital Harbor itself.

The foundation's second effort at creating jobs programs reflects hard-won lessons from its first attempt, says Sean Grimes. "STEM Engine was based on this naive notion that once [kids] had the tech skills, they would be

employable,” he says. But many Digital Harbor kids hadn’t had a job before, and no one was teaching them how to be a good employee.

One kid got a job at a cable company help desk and left his Digital Harbor job without giving two weeks’ notice. “It was completely foreign to him,” Grimes says. Others don’t know to call ahead when they’ll be late because of a late bus. “There are lot of things we take for granted in having employed role models in our lives,” he says. So Digital Harbor aims to teach what Grimes calls “productive adult skills.” (He doesn’t like the term “soft skills” because he thinks it implies they’re easy to learn and teach.)

In the spring, Digital Harbor aims to start a new Web development job program for teens, say the Grimeses. App development jobs may be next.

Meanwhile, the foundation is spreading its model through professional development for educators. Its staff has visited Arizona, California and Louisiana to show public school teachers, college professors, librarians and after-school program aides how to introduce 3D printing to students. This month, McCoy and other young staffers spent 10 days in Idaho, delivering three workshops for teachers. It’s a reverse-generation passing-up of knowledge, with tech-forward millennials, many in their early 20s, writing curricula and running workshops for veteran teachers.

“They’re incredibly helpful with promoting the idea of making,” says Kristine Buls, the lead science teacher at Baltimore’s Cross Country Elementary Middle School. “They want to get it to as many schools as possible.”

Buls first turned to Digital Harbor for help spending a grant for 3D printers in 2015. The foundation’s staff provided advice and technical support, and McCoy came to Cross Country to train five students in maintaining the printers. Now, when the sensitive machines malfunction during class, Buls deploys a student to fix them so she can keep teaching.

When Buls’ first attempt to start a maker space at her school didn’t work out – the kids seemed lost when told to use their creativity without structure –

she met with Steph and Shawn Grimes and another foundation staffer. They helped her design a more modest, manageable program that introduced maker concepts more slowly.

“They gave me sources, met with me, and made me feel better so I could keep teaching and not quit,” Buls says. “That level of support is typical for them. [They got] no monetary value at all. It’s very much about relationships and making.”