Invention U

School STEM collaborations with college and grad students yield wins for all

By **Addie Matteson**

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If you visit Mitchell Elementary School in Ann Arbor, MI, on the right afternoon, you might be greeted with an unusual sight: local University of Michigan (UM) graduate students and kids knee-deep in a "pop-up" maker space. The students might be immersed in 3-D printing, knitting a scarf, coding a video game, or creating something profound from the "junk box."

The maker space and university students who work there are part of a program called Michigan Makers, now in its fifth year, in which graduate students from the University of Michigan School of Information (UMSI) visit local schools armed with tools for a community making experience—including material for sewing and friendship bracelets, along with 3-D printer and coding supplies. Most important, they bring a passion for providing kids with opportunities to be creative and make choices.

On the other side of the country at a Boys & Girls Club in Redwood City, CA, undergraduates from Stanford University can be found teaching afterschool courses in science and technology to an enthusiastic crowd of sixth graders. The Stanford students are part of a volunteer program called Science in Service (SIS), now in its 10th year, which brings exciting science-learning opportunities to local students and families.

These are just a few examples of K–12 schools and organizations teaming up with local higher education students to bring unique STEM (science, technology, engineering, and math) learning opportunities to kids. Some collaborations are initiated by universities, as part of teacher training or volunteer programs. Others are formed when K–12 schools and teachers reach out in search of new ways to engage their students in science learning.

Making and digital citizenship

The Michigan Makers pop-up maker space program was created by UMSI clinical associate professor (and former school librarian) Kristin Fontichiaro. It began as an afterschool coding program at a local middle school and evolved to include more activities such as paper crafting, sewing, and using microcontrollers. When the program evolved into a partnership with Mitchell Elementary, it took on the much broader focus of "attracting and retaining

Above: La Salle University students evaluate a cardboard stool that Plymouth Whitemarsh high schoolers made during a rapid prototyping exercise. Below: STEM-infused Pokémon Go at St. Thomas School in Madison, SD, developed by Dakota State University students.

diverse makers," Fontichiaro says. The aim now, she notes, is to "introduce students to a variety of media, so they can discover and engage with a variety of tools and materials."

Each week, the Michigan Makers choose to work on anything from building circuits to creating musical scores for silent films (with instruments they check out at the Ann Arbor District Library). The goal, Fontichiaro says, is twofold: to give the graduate students the experience to be "creative and confident mentors of youth" and to help their elementary learners "develop a sense of interconnectedness and collegiality, and develop confidence and agency."

A middle school digital citizenship initiative, also from UM, began as a way to address several challenges. In 2012, graduate student teaching interns working with Liz Kolb, clinical assistant professor at UM School of Education, approached her with concerns about unsafe online behavior they were encountering at their placement school, Scarlett Middle School in Ann Arbor. They expressed their readiness to work with kids on issues concerning cyber safety.

At the same time, Scarlett was transitioning to the International Baccalaureate (IB) curriculum and seeking ways to integrate inquiry-based units into its English Language Arts (ELA) classes. Kolb sat down with the Scarlett ELA teachers, and together they created a pilot program with two objectives: "To prepare new teachers to be able to teach about and facilitate deep conversation about being safe, responsible and respectful online," and "to help middle school students learn how to be safe, responsible, and respectful online by participating in rich and sustained discussions and developing digital posting guidelines for the school community," she says. For five years now, her graduate student interns have been partnering with Scarlett's ELA teachers on a monthlong digital citizenship course.

The choice to implement their program in a middle school was deliberate and well timed, according to research. Kolb's students found that, statistically, middle school is the time when most students transition to owning mobile devices and participating in social media. Also, younger teenagers are less likely to speak up when they witness inappropriate behavior online. The first year, two eighth grade ELA classes took part in the program. This year, Kolb had over 50 interns involved, and every student at Scarlett—more than 400—took part.

Gotta catch STEM all

The students at the St. Thomas School in Madison, SD, work with associate professor Mark Geary's Technology in Education students from nearby Dakota State University regularly, but this fall, they were treated to an experience that brought that collaboration to a whole new level. The St. Thomas fourth graders got the chance to view STEM learning through the lens of the wildly popular mobile game Pokémon Go.

Over the summer of 2016, Geary observed his own children playing the game with so much absorption that an idea occurred to him: "I wanted to harness that engagement for education." With the help of his own students, he put the idea in motion. The experience of playing Pokémon Go was reframed to have students search not just for Pokémon characters, but examples of science, technology, engineering, and mathematics, while pursuing the fictional creatures through the augmented reality of the game. When students found an object, they documented it with a screen shot. Then they created a class presentation about of the object and the ways in which it represented the STEM principles they had studied at school. As anticipated, engagement was high, and the experience was memorable for both the fourth graders and undergraduates.

Tackling real-world problems

Modeled after a program at La Salle University, the Open Minds program at Plymouth Whitemarsh High School in Plymouth Meeting, PA, is a STEM competition in which student teams brainstorm solutions to world problems. At a recent competition, working at the maker space with library media specialist Sara Frey and La Salle student mentors, the teams read about

Photo courtesy of Sara Frey; screenshot courtesy of Mark Geary

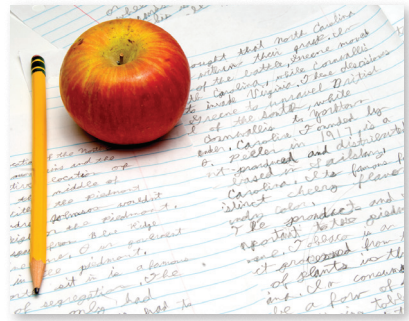
Why Med School Students Tutor at My Library

Tutor Time, our library partnership with students from the Cooper Medical School of Rowan University (CMSRU), began in September 2013, when I was a youth services librarian at the Ferry Avenue Branch of the Camden County (NJ) Public Library. Brian McCauley, a CMSRU student, contacted me about having medical school students reading to kids as part of CMSRU's curriculum of providing community service to Camden residents.

In the past, we had tried to partner with a local university's education students. But as their workload intensified and class schedules changed, it was hard to maintain consistent programming. The university withdrew.

It was particularly busy in our branch when McCauley arrived for our meeting. Kids were asking for help with algebra and geometry while I was answering the phone, assisting in the computer lab, and fielding requests for snacks. I asked Brian on the spot if he could help the kids with their math problems. He did, and the next day he proposed the tutoring initiative.

CMSRU students must complete 40 hours of service learning a year (or about



one hour per week or two hours every other week). It was important that our library projects expose them to the socioeconomic and cultural barriers faced by many Camden residents.

Our short-term goals included assisting children with homework; providing positive role models; encouraging a respectful learning environment; inspiring kids to read and think critically; modeling healthy eating habits through a food enrichment program; and learning about Camden through the eyes of the kids.

Our long-term goals included collaborating with library staff to address other needs the children might have; fundraising and seeking grants for more programs; and improving CMSRU-Camden community relations. We agreed that we needed a yearlong commitment to provide consistency for Camden children, who frequently have people disappear from their lives. We also designed a rotating leadership structure with at least two tutors, so the program won't collapse if one could no longer volunteer. Our leaders are always in different years of training, so that when the older one rotates out, the other takes over. Tutor Time now meets four days a week, with six to eight tutors on any given day. In 2014, I received the CMSRU Martin Luther King Jr. Service Award for outstanding commitment and service to the Camden community.

Recently, I ran into some students from our original 2013 group. My heart swelled as I listened to Justin and Tomas bicker goodnaturedly over which classes "counted" more to get them into college. Both plan on careers in medicine—like their mentors.

Lisa K. Brandenburg is senior librarian, youth services at the Anthony P. Infanti Bellmawr Branch of the Camden County (NJ) Library.

the United Nations 17 Sustainable Development Goals, which address problems including poverty, hunger, and the environment. Their action plans incorporated elements such as algae, recycling, and roadkill. The teams had two weeks to develop their plans, and at the end, they delivered pitches to school and community members, according to Frey. They also visited the La Salle University maker space.

Frey hopes that the relationship with La Salle "leads to new initiatives, such as specially designed internships for our students." A post-survey showed that the students appreciated the challenge of working as a team outside of class time and believed they developed time-management and communication skills. They also liked approaching the challenge by applying their knowledge and experiences across subjects. Frey hopes to expand the program to feature guest speakers, short one-day challenges, and other events, she says, and "our administration has discussed partnering with other universities for similar or different student programs."

Logging volunteer hours—with science

Students at Stanford University who are looking for a unique service opportunity can volunteer for the SIS program, run out of the university's Haas Center for Public Service. SIS began a decade ago with a NASA grant to create an outreach program

A Stanford University student demonstrates a reflective light box made with rolled Mylar, tracing paper, and cardboard at a Boys & Girls Club in Redwood City, CA.

From top: Thinkstock Images; photo by Sarah Koik

Finding Higher Ed Partners

SCIENCE CAN BE a little "more hip coming from a college student," Kolb says. So if you are wondering if you should pursue a collaborative relationship with a local college or university...just go for it! Some schools have service programs similar to Stanford's, but don't fret if you don't live near one of those schools. Education schools and professors are always looking for new ways to connect their students with K–12 classes. Reach out, especially to educational technology professors, for mentors and collaborators. Check out the news coming from your local college or university, and take note of any projects or competitions that connect to STEM topics in your students' curriculum. These projects can be gold mines for potential "expert" mentors.

These collaborations are as meaningful for the college students as they are for their young partners. Stanford junior Amy Liu has been volunteering with the SIS program since her freshman year. She describes the experience as nothing less than transformative. "Teaching has given me a more open mind, a bigger heart, an awe for the universe, and an ever-increasing desire to share that awe with others," she says.

At Michigan Makers Toy Takeapart events, students learn to handle tools (below left) and dismantle toys to see how circuits and electronics power them. Kids dissected an animatronic Santa (above) over the course of several sessions.

on solar research. Today, though they continue to have a lasting partnership with the Boys & Girls Club where it all began, and the program also encompasses several STEM subjects. Students at the Boys & Girls Club sign up to participate in seven-week courses that focus on a theme, such as circuits or electricity and magnetism. Each week a standalone project builds into the next week's activity, creating a deeper conversation.

The goal, says Sarah Koik, SIS program director, "has stayed the same: [to] train novice facilitators—Stanford students—in best practices around informal science facilitation, and to frame this work in the broader conversation around education equity." According to Koik, many students sign up to gain some volunteer hours and get out of the "Stanford bubble"—and find the experience to be rewarding on its own merits.

High yields all around

The impact of these collaborative programs on both the higher education facilitators and their young participants is huge. "The highlight for me is probably having students take responsibility for the activities we bring in after we've had the activity for at least a week," says Ben Rearick, one of the graduate student facilitators in the Michigan Makers program. According to Fontichiaro, several of the former students have gained employment opportunities from their involvement in the program. But the intangible gains have made the biggest impact. Fontichiaro describes one participant, a young boy from a challenging home situation and more energy than he could contain, who discovered a way to calm and control himself by making friendship bracelets. "He taught us all that making isn't always about skills and future career aspirations," she says. "Sometimes, it's about having time to self-soothe: to become quiet with one's self; to take pleasure in materials for materials' sake."

The students who participate in Stanford's SIS program have had equally profound experiences. "You can't begin to measure the amount of impact that this partnership has with our students," says Damien White, associate director of the Boys & Girls Club of the Peninsula in Redwood City, CA, which partners with SIS. Typically, the sixth graders they serve have had very little science education, and the SIS program does a lot to bridge that gap.

White described a boy who didn't appear to be grasping the concept of circuits during the program. Later, though, he brought in a remote-control car he was able to take apart and repair based on what he learned from the SIS course. That car continues to run now—one year later.

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Photos courtesy of Michigan Makers of the University of Michigan School of Information