Epsilon Summer Programs Cultivate Students' Joy and Confidence in Mathematics

Scott Hershberger

In the early 1990s, calculus classes were routinely available for high schoolers in suburban schools outside Boston. In the city—where more Black, Latinx, and economically disadvantaged students lived—few schools offered calculus, citing a lack of student preparedness.

Bob Case, a professor at Northeastern University and an alum of Boston Public Schools, knew that students in the city had an untapped potential to thrive in calculus, if only given the chance. So he founded Bridge to Calculus in 1994 with the goal of closing the gap in preparedness and access.

In the years since, "it's impacted Boston Public Schools to the point that schools have opened up AP Calculus because the students are ready," says Rajini Jesudason, a lecturer at Northeastern and current program director of Bridge to Calculus, which was one of 24 summer mathematics programs to receive Epsilon Awards for Young Scholars Programs from the AMS in 2021. Funded by AMS donors, the Epsilon Awards aid and promote programs that support and nurture mathematically talented youth in the United States.

Despite last summer's challenging circumstances due to the COVID-19 pandemic, students attending programs across the country were able to meet virtually to find inspiration, community, and joy in mathematics. As a result, they gained confidence in their own abilities and explored topics beyond what they could learn in school. Here's a look at three of the programs that received Epsilon Awards in 2021.

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Bridge to Calculus

Bridge to Calculus is a free six-week summer program in which teachers from Boston Public Schools help incoming juniors and seniors gain the math skills needed to take calculus the following school year. Since most student attendees have jobs or other responsibilities during the day, classes run 7:30–9:30 a.m. Monday through Thursday. The program is typically held on the Northeastern campus, though it met online in 2020 and 2021.

Christopher Suplice is among the curious and motivated students to benefit from the program. Suplice immigrated to the US from Haiti in 2016 to seek treatment for a rare, inherited form of vision loss. Attending Bridge to Calculus the following year gave him the skills and confidence to take calculus in high school, and activities after class introduced him to coding.

"The program can be life-changing, because it's more than just a precalculus program," Suplice says. "It gives you this different perspective into what you might want to do

Figure 1. Rajini Jesudason (third from left) and Bridge to Calculus co-founder Donald King (second from right) with a group of students who learned coding after classes in 2017.

in life. It has that family feeling." Now studying computer science at Northeastern, he returned as a program mentor in 2021 to give back and help other students reach their goals.

Some Boston Public Schools teachers have been involved in Bridge to Calculus for a decade or longer. Juan Tapia, a math teacher at John D. O'Bryant School of Mathematics and Science, has been both a mentor and teacher at Bridge to Calculus. For students and teachers alike, "there's something to being in a room full of kids who want to do math and are asking questions that can be motivating," Tapia says.

During the pandemic, Jesudason says, demand for the program has increased as more students have struggled in online classes. In response, she launched an evening "question center" where attendees could ask the mentors about math, college, and life in general. The virtual space quickly became a community hub, so Jesudason kept it running throughout the school year. And the Epsilon Award, which Bridge to Calculus received for the first time in 2021, went toward raising the number of mentors to give students more individualized attention.

Figure 2. Boston Public Schools students at Calculus Field Day, an outreach event associated with Bridge to Calculus. Each April, students compete in groups of three in preparation for the AP Calculus exam.

The 2021 program included experiential education activities on Fridays inspired by two brothers' 1956 bicycle trip from Mexico to Canada. A conversation with the one living brother, visits by Boston Debate League teachers, and tours (both virtual and in-person) of the Isabella Stewart Gardner Museum encouraged students to discuss contemporary social issues related to the journey. Plus, it provided real-world examples of concepts that underpin calculus, such as average rate of change and periodic functions.

By design, Bridge to Calculus has positively impacted the education system as a whole rather than giving special treatment to certain students. "It's this circle that feeds itself: The students are getting stronger, [so] the [public school] classes improve. When the classes improve, the students get stronger," Jesudason explains. She has no doubt that students in urban schools have just as much potential as those in suburban ones. This underscores the importance of access to high-quality math classes and "showcases how inquisitive minds can flourish given the right atmosphere," Jesudason says.

Joaquin Bustoz Math-Science Honors Program

When Gabriela Perez Barrales found out about a college transition program at Arizona State University (ASU), she thought it was too good to be true. As a high school student, could she really take summer classes taught by ASU professors and receive college credit—all for free?

The Joaquin Bustoz Math-Science Honors Program (JBMSHP) offers high school sophomores, juniors, and seniors from underrepresented backgrounds the chance to be a college student with a safety net. In addition to taking a college class (last year College Algebra, Pre-Calculus, Calculus for Engineers, or Principles of Programming with Java), each student receives invaluable mentorship, building community with current ASU students and each other. JBMSHP has received Epsilon Awards in 2015, 2020, and 2021.

"It's an amazing support system, and I've gotten so many other opportunities that I wouldn't have gotten [otherwise]," Perez Barrales says. A first-generation student from Phoenix, she attended JBMSHP in 2020 and 2021. She is now a first-year student at ASU studying computer systems engineering—a field that she discovered while talking with ASU students at last summer's camp.

Founded in 1985, JBMSHP draws students from across Arizona. Normally a residential program with weekend activities and excursions, the camp has adapted to an online format during the pandemic. "Success coaches" filled the roles of residential advisors through both one-on-one and group meetings. Aside from the camp coordinators and professors, all the staff are ASU students. Many are themselves alumni of JBMSHP.

Figure 3. Students at the 2019 JBMSHP make the "Fork 'em Devils" hand sign, symbolizing the ASU Sun Devils mascot.

"I can't stress enough how much this program has impacted my career," says Claudia Rivera Garcia, who attended JBMSHP in 2014. Working there for five summers has contributed to her desire to bolster diversity and inclusion in a variety of fields. She is beginning a master's degree as a Thomas R. Pickering Fellow in International Affairs Policy and Analysis at American University, after which she hopes to work in government. "It's one thing to look at the major from the outside and just see the major classes, but it's a whole other playing field to see […] how someone that looks like you, thinks like you, and has the same background as you navigates that major in college."

While JBMSHP provides a launchpad to colleges around the county, about 60% of recent attendees have gone on to attend ASU. A resource center at the university connects JBMSHP alumni with tutors, also serving as a community hub where friendships formed over the summer continue to thrive.

Figure 4. Students at the 2019 JBMSHP.

Those friendships can last a lifetime, according to Cindy Barragán Romero, the JBMSHP program manager, and Ciera Duran, the JBMSHP coordinator. Both are alumni of the program who went on to attend college as first-generation students from small rural towns. "All my best friends I met that first summer in the program, and we've been best friends ever since," Barragán Romero says. Duran originally planned to attend community college, but JBMSHP showed her that she could be successful at a four-year institution like ASU, so she enrolled there.

Epsilon support "has been instrumental for us to be able to continue the program at the quality level that we're expecting," Barragán Romero says. She noted that expenses like housing and tuition continue to rise, while budget cuts have forced the program to decrease the number of attendees.

For tutor and success coach Ryan DiFranco, the most rewarding part of working at JBMSHP is seeing students who think they won't succeed in college come to realize their potential. "Anyone who's in this program is going to make it through college if they put their mind to it," he says. DiFranco exemplifies the camp's success: He attended the program in 2015–2017, earning 11 university credits. This year he graduated from ASU with a degree in chemical engineering and a minor in mathematics.

New York Math Circle High School Summer Program

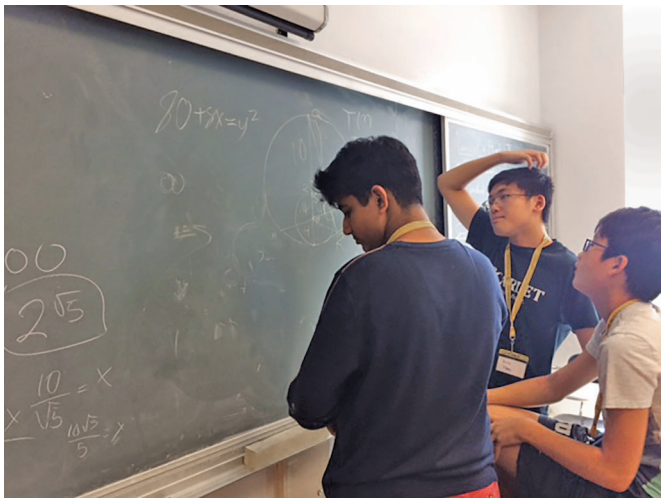

Figure 5. Students at the 2019 NYMC Summer Program collaborate on a math problem.

Proof-writing, the pigeonhole principle, graph theory—these important mathematical tools are rarely taught in high school math classes. For students proficient in school math, the New York Math Circle (NYMC) offers a collaborative environment to explore concepts beyond the standard curriculum.

Although NMYC operates year-round, the Epsilon Award specifically funds the high school summer program, which runs four hours a day for three weeks. Classes are divided into four levels, ranging from an introduction to proofs and problem-solving to a taste of college-level topics. Nearly all the NYMC instructors are full-time teachers in area schools who bring strong mathematics skills as well as a pedagogical view of the subject.

"It's a very open space, so you can always share what you're thinking," says Sage Lappas, a high school sophomore who has attended NYMC during the past two summers as well as the 2019–2020 school year. "Even if you're unsure about your answer, it's always encouraged that you share it so that the group can talk you through it." The Math Circle helped her prepare for math competitions, also giving her the opportunity to participate in contests that weren't previously on her radar.

NYMC is so highly regarded that even before the pandemic, the in-person summer program drew attendees from across the United States and countries such as South Africa, the United Kingdom, Singapore, and Canada. Now, with

classes online in 2020 and 2021, that reach has continued to expand to India and elsewhere. Post-pandemic, NYMC will shift to a mix of in-person and online offerings.

NYMC teachers have devised creative ways to keep students engaged online. Misha Shklyar, a teacher of the intermediate level, introduced new concepts with TED Ed riddles. He also led his class in a game called "King of the Hill" where students raced to solve problems and accrue points. Lappas says these friendly competitions were a highlight of the summer program for her, as does Jaywu Jun, another sophomore.

"I'm one of the only 'math people' in my school right now, [so NYMC] is a place where I can enjoy math while not being alone in it," Jun says.

Figure 6. A student at the 2019 NYMC Summer Program holds an origami truncated icosahedron.

As the number of high schools with math teams dwindles, the demand for math circles is rising, according to Kovan Pillai, the executive director of NYMC. The New York Math Circle is particularly attractive because "we're not ultra-competitive at the bottom end, so people can get into our program relatively easily," he says. "Giving the experience of problem-solving to a wide range of students is part of our mission."

NYMC began its summer program in 2008 and has received an Epsilon Award seven times. The award funds the attendance of lower-income students for whom the full cost would be prohibitive. Students often attend NYMC multiple times, both over the summer and during the school year, as they advance through the levels.

"It's not only the financial support that is useful, but also the acknowledgement that we have a strong summer program increases our visibility" nationally and internationally, Pillai says.

In addition to its programs for high schoolers, NYMC runs academic-year programs for middle schoolers. Just before the pandemic, it introduced one-off elementary school workshops. In the future, Pillai hopes to offer academic-year programs for elementary schoolers, thus rounding out NYMC's enrichment opportunities for students of all ages.

Pillai says the most rewarding part of his work is cultivating students' joy and confidence in math, a sentiment echoed by the leaders and teachers of JBMSHP and Bridge to Calculus. As for Lappas and Jun, both intend to use math throughout their lives. Jun plans to study computer science in college, applying what he has learned about logic and graph theory; Lappas has yet to pinpoint a college major, but she knows that math will play a central role in whatever she decides to study.

About the Epsilon Fund

In 1999 the American Mathematical Society established the Epsilon Fund endowment to help support summer mathematics programs for mathematically talented high school students. The name for the fund was chosen in remembrance of the late Paul Erdős, who was fond of calling children "epsilons." The goal of the program is to aid and promote programs that support and nurture mathematically talented youth in the United States and to make these opportunities available to the broad pool of all mathematically talented high school students living in the United States.

See a list of past recipients of Epsilon Awards at `https://www.ams.org/prizes-awards/paview.cgi?parent_id=3` and learn how to donate to the Epsilon Fund at `https://ebus.ams.org/ebus/Giving/MakeAGift.aspx?gift=EPSILON`.

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Credits

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