Community Case Study

JV INVENTEAMS INITIATIVE BUILDS FOUNDATION FOR TEACHER'S STEM CURRICULUM

Administrators at KIPP Sunnyside High School, a public charter school that opened in 2010, invited Kyle Kenan to start a Science, Technology, Engineering and Math (STEM) program in 2013. The STEM program is the first in the 28-school KIPP Houston system. School leaders wanted students in the Sunnyside community, the oldest African-American community in southern Houston, to be exposed to STEM. They hoped it would lead their students into careers that would lift them out of poverty.

KIPP Sunnyside High School has more than 500 students and of those students, 85% are African-American and 15% are Hispanic. The school consists of mostly underserved students and qualifies for Title 1 funding for having a high percentage of children from low-income families.

It's against this backdrop that Kenan, a 2011 graduate of Morehouse College (an HBCU - Historically Black College and University), accepted an offer to teach at KIPP and start their STEM program at KIPP Sunnyside High School. Kenan's previous teaching experience had been as an algebra teacher at a middle school in North Carolina and a mathematics teacher at a preparatory middle school in Houston. Teaching STEM, especially engineering, is his passion.

"In the beginning, I thought I could teach [students] engineering and they could get rich. What we all learned was that engineering should be used as a pathway to help people and lift up the whole community." – Kyle Kenan

This viewpoint became the philosophy for his instruction – Service through STEM. The first days were difficult, he acknowledges, as the school district, despite having high hopes for the addition of STEM, had allotted him little to no budget. "We were learning with cardboard and rubber bands," Kenan says. In fact, one of the first projects his STEM students created was a rubber band car.

Kenan knew if these students were going to compete for spots in universities and the job world, they would need more than their imagination. They needed significant hands-on learning. He

began to gather supplies and, like so many other teachers, apply for grants. His first big donation was a whiteboard, which he used to help students visualize problems and work through solutions. He became familiar with Rice University's Oshman Engineering Design Kitchen (OEDK), which is located a short distance from KIPP Sunnyside. The program helped to fund an engineering design kitchen at KIPP Sunnyside where his students could gain hands-on learning experience with tools. Coincidently, the director of OEDK, Dr. Maria Oden, was a co-recipient of the Lemelson-MIT Award for Global Innovation in 2013. Soon after, the Lemelson-MIT Program would also play a role in Kyle's new STEM Program.

Kenan was introduced to the Lemelson-MIT program and its Junior Varsity (JV) InvenTeams initiative, which was in its infancy in 2013, by the then director of the STEM Program for KIPP Houston Public Schools, Omah Williams-Duncan. She was familiar with KIPP Houston High School - a school that had received a Lemelson-MIT InvenTeam grant in 2012. The JV InvenTeams initiative works with younger students in grades 7-10 to enhance their STEM skills through invention-based design activities. Kenan thought that JV InvenTeams would be a great way to introduce his students to hands-on learning, while enriching their STEM skills. He agreed to have his 100 students pilot the project-based JV InvenTeams initiative's activities.

"We got power tools and glue sticks and [invention] kits from the JV InvenTeam," he says. At the same time, the grant he submitted to energy giant BP came through for $25,000 worth of computer equipment. By the second semester of his second year at KIPP Sunnyside, he had enough supplies for KIPP Sunnyside's design kitchen for building and tinkering, located across the hall from his classroom, complete with a 3-D printer and many large power tools.

As the supplies came together, Kenan says he struggled with the type of curriculum to follow. Some plans relied on cutting-edge technology that he, at the time, did not have. Others, he found, lacked interactivity to engage the students.

The project-based offerings of JV InvenTeams and the University of Texas' Engineer Your World curriculum, he says, provided the perfect blend of invention, innovation, and instruction, enabling him to match his students' skills and creativity to the task at hand.

"Both programs showed us how engineering interacts with the real world," he says. For instance, one JV InvenTeams module had students research developing countries and relate their problems to ones the students themselves had encountered. The problems students worked to solve included creating water storage containers that wouldn't allow bacteria to grow. It was through JV InvenTeams, which KIPP Sunnyside participated in for two years, that Kenan began to realize that these students could engineer solutions to the problems plaguing their own communities.

" The issue we have in engineering is that the people trying to solve the problems aren't the ones suffering from them. They don't understand the complexity of the problems. "

This epiphany led him to have his seniors (many of whom had participated in the JV InvenTeams initiative) apply for the Lemelson-MIT InvenTeam grant in 2015 to invent an autonomous pothole remediation device. "Our streets here in Houston are bad with so many potholes," which he says causes wear and tear on cars and city infrastructure.

The students designed and built a robotic device that could do a better job of filling potholes with longer lasting results. Initially, they thought their focus would be on the drivetrain engineering, but their improvement to the standard "cold

patch" material the city uses and what the team dubbed "Formula X" was their focus. Formula X better catalyzes than cold patch, making it less susceptible to cracking under heat and pressure. It became the centerpiece of their invention, earning them tremendous praise and a plaque from Texas Gov. Greg Abbott. They also held in-person meetings with community faith leaders and elected leaders, including U.S. Rep. Al Green (Texas's 9th district), Houston Mayor Sylvester Turner (who issued a proclamation designating March 29, 2016, as KIPP Sunnyside InvenTeam Day), and the Houston City Council. The city and county agencies responsible for repairing the city streets were so impressed with Formula X, they asked to buy it. Kenan's InvenTeam formed an LLC, thanks to a donation from a community partner, and is in the process of registering the formula as a trade secret and then will work with the city to use it.

"InvenTeams brought a lot of confidence to these students and a sense of necessity for them to be successful – not so they can say 'I'm so intelligent' but to solve the problems that pertain to their community," he says. "At that level of engineering, you are taken out of a place where you're judged by teachers and peers to where you are judged by professionals."

He was also amazed at how proficient his students became in writing letters to elected officials and others with whom they wanted to meet. "They have these soft skills they never would have had that allow them to be advocates for themselves. Whatever happens next, they've all experienced that," he says. One of the best parts of the InvenTeam experience, in his opinion, was the opportunity to make mistakes. His team captain – one of 15 students who attended EurekaFest at the Massachusetts Institute of Technology (MIT) to showcase and present their invention project – froze when she made her presentation. "Her teammates had to step up and be there for her," he says. "It was such a great experience to have that failure and together push through." Kenan is proud of his InvenTeam, 80% of whom went on to pursue STEM or pre-med majors at four-year institutions, including Rice University, Spelman College, University of Houston, and the Texas A&M University System.

As his students move on, Kenan, who holds the title of STEM Coordinator and STEM Curriculum Write & Course Lead at KIPP Sunnyside, is pursuing a master's degree at Columbia University and contemplating how to mimic the InvenTeams experience across the 27 other KIPP Houston schools. "I don't think anyone could have anticipated how fast it would grow," he says. "That's a testament to our partnerships with organizations like MIT and our relationships with the community."

His advice to other InvenTeam leaders is simple: "Be bold and believe in your students. Believe in their capabilities. There were so many times when we were so afraid because we didn't know if we were doing things right, if we were good enough, if we were going to meet deadlines, but the students always were able to go above and beyond any expectations I had."

ABOUT LEMELSON-MIT INVENTEAMS™

Lemelson-MIT InvenTeams are teams of high school students, educators, and mentors that receive grants up to $10,000 each to invent technological solutions to real-world problems. The InvenTeam initiative is administered by the Lemelson-MIT Program, a sponsored program under the School of Engineering at the Massachusetts Institute of Technology, The Lemelson-MIT Program is funded by The Lemelson Foundation. Learn more at lemelson.mit.edu

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