

Educator Case Study

INVENTION EDUCATION: CHANGING HOW TEACHERS “TEACH”

When the Computer-Aided Design Engineering Program at Frederick County Career and Technology Center (CATC) in Maryland missed winning a Lemelson-MIT InvenTeam grant on their first try in 2015, instructor Phil Arnold, a 2015 and 2017 Excite Award recipient, considered it a win. He could illustrate an important concept in invention: There is tremendous opportunity in failure.

The class had started their Lemelson-MIT InvenTeam journey the year before when a student – an 11th grader – came across the grant program while searching for competitions and challenges. The CATC is a two-year technical program that accepts students from eight area high schools. The 11th grader studied past grant winner submissions, intrigued by the purposeful nature of them, and decided his team should focus on the problem of potable water in Ethiopia.

The team developed a harness that people in a small village could wear that would significantly lighten the load of transporting water from the Awash River, a good distance away. Unfortunately, the idea did not get the green light from the Lemelson-MIT InvenTeam judges; there were other

types of water transportation devices so this good idea did not meet the grant requirement of being unique. Arnold suggested other devices for inventions but the team wanted to keep going on their harness invention – without the grant.

It was in that moment that Arnold’s strategy for classroom instruction was reinforced:

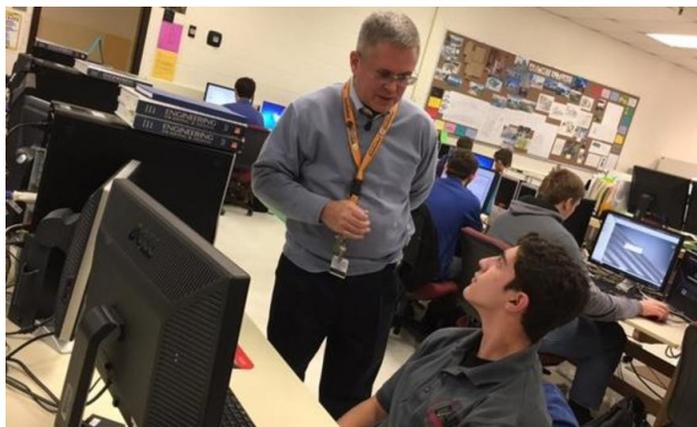
“ When you teach students how to build something, you engage their hands and minds. If you let them choose the project, you engage their hearts. ”

He has seen teachers struggle to engage students. “When you’re doing a lecture or lab or going through course materials together, you are completely in control of the activity. And you need to be because perhaps some of those students are not going to be as engaged in what they’re doing,” Arnold says. “But you also spend time worrying about how to get everyone from Point A to Point B.”

Invention changes that. “If you let them pick their projects, you don’t have to put so much of

your time and effort into classroom management because the engagement is natural," he says.

Arnold, who has a bachelor's degree in engineering from Virginia Tech and worked in communications and information technology, says he is fortunate to have come to teaching as a second career seven years ago.



He finds himself stepping back from traditional instruction because "I am in the way and I am slowing down what they are learning from each other."

By the time the team's invention was not selected for grant funding, they were already a cohesive unit working towards a goal. In the spirit of InvenTeams, though, they still went around in their community to raise money and boost awareness of the real-world problem they were trying to solve. "Whether you receive the Lemelson-MIT InvenTeam grant or not, you still have to get your school and community at large excited about the project and behind it," he says. They visited international service organizations such as the local Rotary Club, and that's where they met Jo Elizabeth Butler, founder of Ethiopian Children's Appeal, who was in the audience and would become a critical part of their path forward.

“ The InvenTeam initiative is not focused on who gets a gold medal. It's about elevating invention and changing education to incorporate invention for all students. ” – Phil Arnold

“To solve a problem that doesn't have a solution – the definition of invention – you have to go to

an external source of knowledge whether that be scientific expertise, business acumen, or political awareness,” he says. “What is exciting about invention at this age is the contacts you make are all positive so you're not discouraged or deflated by rejection.”

The students were able to take that first project through to completion and, in 2016, they began their next go at the Lemelson-MIT InvenTeam grant application. This time, they were successful and joined 14 other teams as the official 2017 InvenTeams.



Arnold's class drew upon the lessons they learned from their first invention and honed in on water treatment and how to build a sustainable water-remediation system to provide clean drinking water to Ethiopia. They worked with their new mentor, Ms. Butler, to identify a partner and beneficiary for their work - the Melka Olba School in Ethiopia. Butler's frequent travels between the two regions will make the testing and validation process for their "rocket stove" water treatment invention simpler as she'll be able to hand-deliver prototypes and help facilitate feedback. The students were unable to do this with their previous invention, which made it more difficult to understand the invention's limitations. The firsthand connection to Butler also has made the experience more vivid, igniting the students' passion in a way traditional instruction could not, Arnold says.

He refers to this approach as "self-driven education," which enables students to work at a greater pace and greater degree of difficulty.

Arnold already is looking forward to EurekaFest at MIT in June 2018 where the students will pres-

ent their “rocket stove” distillation process and showcase their invention along with the 14 other InvenTeams at the Lemelson-MIT Program’s multi-day invention celebration.

“The students understand the potential impact of their invention,” he says. It’s more than just the cost and effort of bringing drinkable water to the village by donkey. Reliable drinking water is seen as an enticement to get students to come to school and to get more people to settle in that area and create economic stability. Arnold elaborates that, “People and animals move based on water. If you can establish a reliable source, then the community [in Ethiopia] is going to become more permanent and stable and grow.”

In fact, Arnold’s students are so committed to this region that the stove is just one of four inventions they are collaborating on with Butler and the Melka Olba School.

The Excite Award he received, he says, was an opportunity for him to grow as well. “No matter what angle you come to teaching from, you will need advice and direction from someone else.” He added that the expertise he received from the Lemelson-MIT master teachers, who are previous InvenTeam teachers who provide peer-to-peer support for current InvenTeam educators, will be put to good use helping his students achieve their invention goals.

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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