

STEM Education for American and Developing Economies “Making in America”

Adam Savage, co-host of the popular TV show *Mythbusters*, mentioned on-stage at MakerFaire 2012 how “budget cuts are taking away all the frivolous -- the quote-unquote frivolous -- things in the high schools like the drama club, and the music department, and especially the shop classes”. While school programs recognize the need for rigorous STEM education, all too often the kind of teaching that aims to encourage and expand the scientific process of inquiry ends up stifling it altogether when taught simply out of a textbook. Students need a way to put their knowledge into practical use, outside of the classroom, without the use of rote, predefined procedures. The process of fabrication inside a machine shop can be a perfect opportunity to do so while also making it fun and relevant to students. However, schools across the country continue to close down machine shops and classes in the face of increasing budget cuts. In order to bring in the next generation of curious, scientific minds, we need to enable our children to become lifelong *Makers*, and bring back this vital access to *Making*.

A Maker is a resourceful individual who can bring a project from concept to final product while leveraging existing knowledge and relying on the right expertise, tools and technologies. A Maker, for example, may choose to replicate a favorite costume on TV, or devise a new piping system to filter water, or to power appliances using alternative fuels. The approach to each of these is deeply intertwined with the scientific method. There must be a demonstrated need as well as a hypothesis as to how to address that need, and a logical, stepwise approach to bringing a proposed solution to fruition. The process must be repeatable, and may require multiple iterations and perseverance until the final product is made. Finally, the product must withstand the rigors and unforgiving forces of the physical world.

The process of Making often requires access to tools such as 3D printers, laser cutters as well as basic machinery, and the knowledge of how to safely manipulate such equipment. These are often costly to purchase and maintain. The mobile shop is the perfect solution for budget-conscious classrooms to afford the opportunity to inspire Making.

At its simplest, a mobile shop is a shop class on wheels, a van outfitted with a laser cutter, 3D printer, vinyl cutter, hand tools as well as enough materials to keep several classes of students busy. It is staffed by volunteers who share their time and expertise leading workshops as well as maintaining the tools inside. The truck itself can be shared among multiple schools in a district, reducing costs at each individual school. Upfront costs can be fairly expensive, though this can be offset by local businesses that can get involved in funding or by leading special workshops.

In conjunction with Prat Ganapathy, who started Stanford’s own mobile shop SparkTruck, I have helped provide funding for their initial mobile shop as it makes its way across the country this summer. But the initiative cannot end there - each community it passes through must learn how to adopt their own truck and develop their own curriculums that tap into their student’s creative and scientific minds. It has to leave behind not only the excited children who have made their first Vibrobot, but also stakeholders and enthusiasts who realize the potential of Making. I am

involved in exploring avenues for maintaining this vision for SparkTruck so that similar initiatives can easily adopt its model, replicate its successes and sidestep its failures. Indeed, a group of parents in Baltimore have already begun pooling funds for their own mobile shop, and Baltimore will be one of the final stops SparkTruck will make in its cross-country adventure. If it can succeed in laying down a foundation for Making in the context of education, then I firmly believe that it can make science, engineering and math more exciting, more useful, and more tangible to students of all ages, all across the United States.