FabNet: Extending the FabLab Classroom

Background

According to the Society of Manufacturing Engineers (SME), personal digital fabrication will offer revolutionary changes for manufacturers and the everyday consumer. In fact, personal fabrication was featured in SME's 2009 Innovations That Could Change the Way You Manufacture list. Advanced manufacturing technologies, such as 3D printers, are transforming engineering education; within the past few years, desktop manufacturing systems have become affordable at the K–12 level.

The FabLab Classroom was funded by the National Science Foundation to explore the use of digital fabrication to allow students to create digital designs that are realized as physical objects, such as model satellites (in collaboration with NASA), wind turbines, and speaker systems. This work provided a context for addressing the Commonwealth Engineering Design (CED) Academies' two goals:

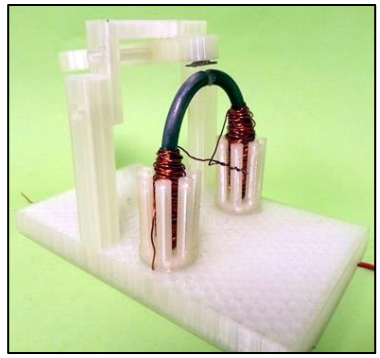
(1) To help create the skilled workforce needed for the future by preparing K–12 students for the jobs expected in the future and related skills required for those jobs

(2) To respond to draft *Next Generation Science Standards* that call for integration of engineering design into science education (National Research Council [NRC], 2011).

Building on the FabLab work and the existing collaboration with the Smithsonian Institution, the University of Virginia will advance the above goals through the Fabrication Network (FabNet). FabNet is designed to ensure that preparation in K–12 schools is aligned with engineering education strategies in Virginia's community colleges and universities.

Documented Results

In a pilot effort, middle school students in a Lab School engineering class reconstructed a reciprocating electric motor invented by Joseph Henry in 1831. They used supporting materials adapted from Princeton engineering labs to develop an initial design, and employed a CAD program (AutoCAD 123D) and 3D printer (Afinia Model H) in the process. The resulting device has strong applicability to the Electricity and Magnetism standards in middle school physical science and, hence, serves as a useful bridge to link the engineering and science classes. The pole-switching circuit that Henry devised to power the device led to one of the first documented instances of an electromotive device that could perform work (i.e., act on another linked device). This invention played a role in subsequent inventions, such as rotary motors with commutators and brushes.



With appropriate scaffolding, middle school students are capable of designing a working reciprocating motor based on the same principles as the original "electromotive device" developed by Joseph Henry. This affords opportunities for novices to design an initial solution to the challenge, with ample scope for refinement.

Potential Applications

The materials piloted in this manner (scanned artifacts, lesson plans, assessments) will comprise case studies that will be hosted by the Smithsonian and used to create a Fabrication Network (FabNet) of schools using 3D technologies in science and engineering courses. The findings will inform the next generation of schools that are planning to integrate engineering education into their curricula.

For More Information

The activities and designs for the pilot activities described will be housed on the Smithsonian 3D printing educational website, http://3d.si.edu/. Other resources that support digital fabrication in the classrooms are available at http://maketolearn.org/.