3D Printing in STEM Subjects and Beyond

Enhancing curriculum with 3D design in project-based learning

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One of the newest technologies being applied in K12 today is 3D printing, particularly in integrated STEM courses. This new technology also has potential application beyond engineering classes, providing creative ways to enhance the curriculum in a variety of other subjects. In this web seminar, originally broadcast on September 8, 2015, two educators from the Marlborough (Mass.) Public Schools discussed how they are using 3D printing in creative ways, including math and history projects, as well as how STEM projects are enhanced by including 3D design challenges.

SHELDON VIGEANT
History Teacher
Marlborough High School
Our STEM program is almost like a little academy within the high school. This is the 5th year of our program. Our goals are to increase access and to eliminate barriers amongst all of our students. We set high expectations for all of our ninth and 10th grade students by teaming them together. So as students enter into their freshman year at Marlborough High School, they are clustered with teams of five teachers. All of our students elect an interdisciplinary project-based learning course. That’s where we focus on the STEM project. We try to focus all of our curriculum using the guiding principle of the engineering design process. Our students are introduced to the process in middle school and then it continues into the high school.

HEATHER KOHN  
Algebra Teacher  
Marlborough High School

One of the grants we received about two years ago is called the Youth CareerConnect Grant. Marlborough receives $1.8 million to use for our STEM programs. Among other things, this grant enabled us to purchase two additional 3D printers, which have opened the door for us to print in our STEM projects. One of the first projects we came up with a couple of years ago is similar to the common physics class egg drop project. This was a great project because all of our ninth grade students take physics, and they are learning about distance, velocity and acceleration in their first term.

Once we had the extra 3D printers, we started thinking about how we could enhance this project. Why were we giving the students only items such as duct tape, popsicle sticks, bowls and paper plates, when we could have them use software and a 3D printer to design a 3D capsule and print it? This was the first year we did that. We
presented our students with these two challenges: They had to make the egg capsule touch down on land and splash down on sea, and it had to be cost-efficient. Also, as Sheldon mentioned, we adhere to the engineering design process throughout. We have our students keep handwritten engineers’ notebooks. They are working in groups for this, so we usually have them think individually about a possible solution before coming together as a group.

**Sheldon Vigeant:** When constructing prototypes, our students usually begin by printing the capsules, constructing the wiring, and making sure the egg can actually fit in the printed capsule. We make a big deal about displaying their work, and about having a testing day where every student feels obligated and rushed to get their work done in time. We invite other teachers and classes to come watch the test. When we test this project, we are integrating math and physics components, and we are testing measuring distance and time, by how close they get to the target. Was it able to float? Did your capsule take in water? Did your passenger survive? But this is just a stepping stone for us. As we incorporate 3D printing into our classrooms and into STEM projects, we have to identify: Is this work enhancing our curriculum, or are we just 3D-printing because we have a 3D printer?

**Heather Kohn:** Of course, I want to do more of this. I’ve been looking online, talking to other math teachers about projects they have done. I didn’t come across too many, so I ended up collaborating with some people on Twitter to talk about how we could be using this in other math classes. We created a global forum for math teachers to suggest ideas. There are already some great ones in there. One geometry teacher wants to have her students design constellations and then 3D-print them as cookie cutters.

**Sheldon Vigeant:** In the history classroom, my project is actually student-driven. A student once proposed a question: Why are certain veterans recognized with medals and others are not? So their challenge was to design a victory medal that honors the U.S. veterans who served in one or more of the great wars. I required their medal to be authentically sized, and it needed to be rendered in 3D. Most important was that their medal had a purpose. Who was their medal honoring? Why should this person be honored? And I had them choose their own clients. How did this enhance my curriculum? I felt that it increased student engagement. It allowed them to individualize what they were passionate about. Some people felt that the cooks of the war should be honored. Other students wanted to recognize just those who liberated camps, or just the women who fought, or other groups.
JESSE ROITENBERG
National Education Manager
Stratasys

Our focus at Stratasys, especially on the education side, is to inspire, lead and grow. We’re here to inspire the next generation to get more involved in STEM initiatives. And as you heard from Heather and Sheldon, they are not doing it just “because I want to 3D-print something.” They are doing it where it makes sense, because they want to get these students engaged. A 3D printer is an exciting piece of equipment. It’s an exciting tool. But if you don’t have the people behind it to make it exciting, then the students are just going to get lucky if they create a cool project. So truly fostering imagination from the teacher level and the student level is what’s really important. At Stratasys we’re going to start providing our customers and our users with more information to help them along. We’re about to launch an eight-module piece that is relevant to architecture, engineering, product design, transportation design, urban design and game character design. It will be short, medium and long, and it will be beginner, intermediate and advanced. And these are all projects that are open-architecture, basically where we’re giving you guidelines of what to do. The students start with a sketch, bring it into a CAD program and then to a 3D printer. We’ve also launched a free curriculum piece. This is mostly for college and university, but we see a lot of high schools downloading it because they will take a key component to use. There are great PowerPoints, videos, STL files—all available at Stratasys.com under the Education page.

In summary, we’re investing in the future of our nation. You saw what Heather and Sheldon showcased. That’s the exciting part—the impact that it’s making on a student, the excitement that it’s creating in a classroom to draw more students in, especially when it’s an elective class. We’re going to develop even more content, and we’re going to find a way to harness the content so you can do quick searches. We’re going to create avenues to train on how to use the equipment further, especially in key areas. We’re also building a certification, so a student can leave a high school classroom having used a 3D printer and gotten to know the design software to create some sort of additive fabrication or some sort of digital badge. And then we’re linking education and industry. Our industry partners have come to us and said, “We need more students with these types of skills.” We’re going to continue to work together to ensure that students learn these skills.

To watch this webinar in its entirety, please visit: