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August 2, 2015

3D Printing Proposal

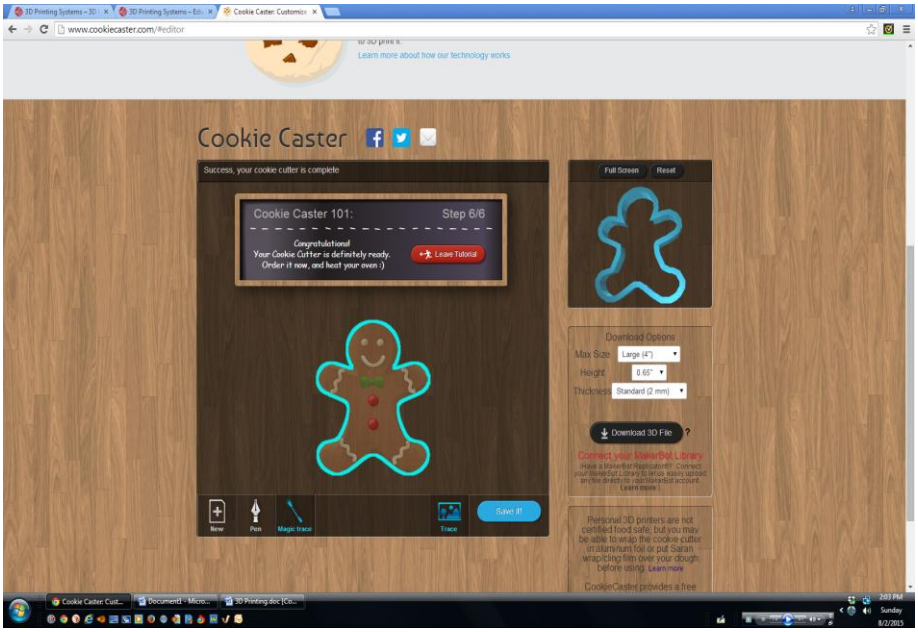
3D printing also known as additive manufacturing is the process of making three-dimensional solid objects from a digital file. 3D technology has been around for quite some time and can be used in the classroom in an active way that helps children to learn or discover new truths, and reconstruct ways of doing or creating and to not just import knowledge directly from the teacher. Seymour Papert (1980) in his book *Mindstorms* believed that students could master technology skills and once children learned to use computers, it would change the way they learn everything else. Decades later, using 3D in the classroom helps children to have a better mindset about learning and creating and innovating that also includes or makes provisions for mistakes. As a YouTube video suggests, one of the key strengths of 3D printing in K-12 and beyond is to help learners to solve real-world problems. A constructionist learning environment gives children the freedom to explore natural interests using new technologies (Bers, 2008, p. 15). As artists and designers, children can learn to prototype ideas, explore product design and learn as is done in the real or business world, how to market their own goods. Students can learn to mold and design using technology, as Michael Angelo molds and sculpts using stone.

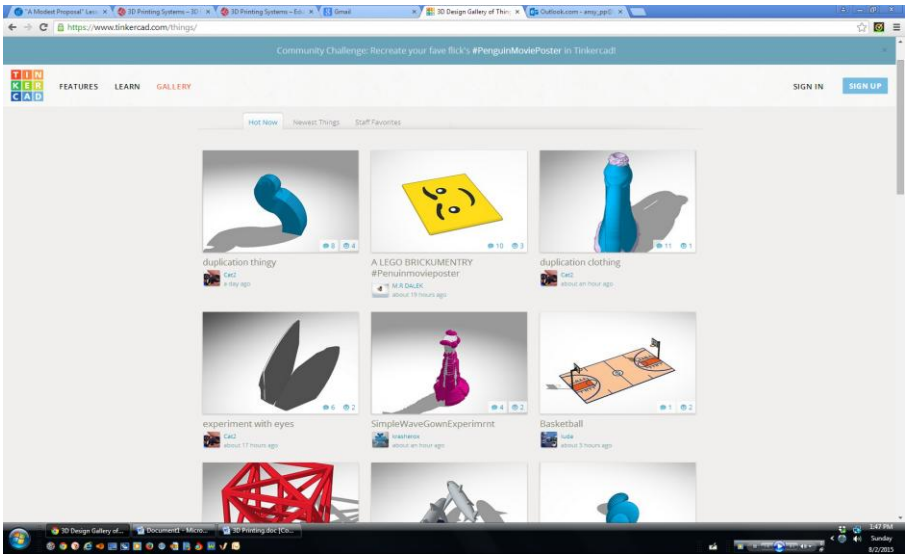
Proof of concept

Subject: Home Economics (Grade: 6-8)

Opportunity. Students can design products that they can sell to other students, which can be used in the home or can design items to be used for future assignments or projects. For example, students can create a board game or some object that students use such as phone covers or jewelry or everyday items such as cups and utensils. Using TinkerCad or Cookie Caster students

can create designs for cookie cutters and other creative designs as prototypes for business, gaming and artistic projects.





Technical procedures

Equipment needed: Computer with Internet connectivity, 3D printer

Application: Cookie Caster Editor, Thingiverse.com

Material: Plastic

Activity. Student can create a cookie cutter that can be used for baking cookies for a cookery class.

Pitfalls. A pitfall for the cookie cutter project is connecting the dots using the pen. If the dots are properly connected then the object cannot be traced or sketched for printing. The creator had to go over the project at least three times before success. This activity requires patience. Another factor or pitfall to consider is personal 3D printers are not food safe, so the student should wrap the cookie cutter in aluminum foil or using Saran wrap or plastic cling before using over dough.

Powerful ideas

Technology instruction has the potential to shape learners' attitudes in positive way towards STEM subjects and in other content-related areas. A constructionist learning environment provides students the creative freedom to use new technologies and supports child development in a holistic way. Emphasis should be given to a child's social and emotional development just as much as their academic development. The powerful ideas are associated with constructionist pedagogy that derived from Papert, Vygotsky and Piaget's work have been largely responsible for shaping the lens through which we see education. Papert was concerned about ways of thinking (imagine children designing tools that could only be purchased in stores). New ways of putting knowledge to use (children can partner with tech savvy parents to make their own household materials from kits, or from parts they find themselves in or around the home). As well as making personal or epistemological connections with other domains of knowledge. In this way, students can figure out ways of behaving as inventors, builders, designers and artists. Constructionists view the computer as a powerful carrier of new ideas and an agent for educational change. They nurture an environment that builds upon powerful ideas.

Imagine the idea of the classroom being used as a laboratory for getting parents involved in student learning through an after-school technology or 3D club (Bers, 2008, p. 92).

Technology Lens

Organizations such as Google, eBay, Quanta, Red Hat, and Marvell are all advocates for the value positive lens of educational technology which promotes the use of the Internet as a major force driving changes in business, civic life, and education to some extent (Culp, Honey & Mandinach, 2003). During the mid-90's, policy reports began to present education technology as a driver of school reform, rather than as a class of tools and resources that, to varying elements, could be matched to educational challenges already recognized by educators (Culp, Honey & Mandinach, 2003; Magana & Marzano, 2014). Papert and Piaget envisioned that technology was a tool of transformation—that would change how schools were set-up, teachers instruct and how children would learn and relate to each other. On the other hand, there is the 'value-negative' lens presented by Richard Noeth and Boris Volkov (2004) that despite schools being flooded with computers, the evidence is mixed as to whether overall student achievement has notably increased or the achievement gap has visibly narrowed as a result of technology in school settings (p. 7). However, McLeod and Richardson (2013) in Principal 2.0 Technology and Educational Leadership, highlights that schools have made significant progress regarding their implementation and integration of digital technologies compared to where they were three decades ago (p. 249).

Projects

1. Students can create a webinar or video using You-tube to teach other students how to design a 3D item for any subject area.

2. Students can create an audio drama about the 3D design process.

3. Food technology students can design molds and other cooking utensils using 3D and create a digi-book (the equivalent to a scrapbook) of important utensils for baking or cooking and present their designs through digital images to other students. Students become authors of their own realities and creations.

4. Students can create a Podcast tour or personal blog of 3D projects that could be used as guides by their peers. The goal of the activity is exposure to learning resources that might be used for learning basic facts about 3D. Podcast tours are bound to be a growing area where informal learning meets formal academic learning (Bonk & Zhang, 2008). Students are able to expand their level of thinking.

Practical considerations for 3D technology use in the ecosystem of the classroom:

- Schools can create partnerships with businesses that sell 3D technology.
- Teachers wanting to introduce this technology into the classroom need to assure their students that mistake(s) will be made.
- 3D is a low-risk and low-cost technology that influences students toward becoming creators instead of consumers. Students want to design and create, instead of buy and consume. If it is too expensive, then schools can start purchase the more affordable pens from DimPrinting (Slack, 2014).
- 3D printers use STL files which can be found all over the internet. Thingiverse.com is a very useful example of a site from which to download files and see the possibilities for using a 3D printer (Slack, 2014).
- Students want to use hands-on-technology that offer practical applications for real-world activities and contexts.

Martha Slack, an educational technology specialist suggests that teachers need to become aware that 3D technology has revolutionized education and can bring about excitement for learning even though these technologies are expensive. As the story of technology continues to be told,

we can see the aesthetic beauty in the shiny design of computers and smart phones and 3D printers. But, Vygotsky if he were around today would recommend that we harness the unseen potential of these technologies in schools since the sensitive role that technology can play in early childhood education can get lost in larger trends in the educational technology field (Shamburg, 2009). Maybe, what we don't see about technology and learning will be what continues to make it useful and bring even grander discoveries in decades to come.

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