

A dark grey background featuring a collage of white, chalk-like sketches of various educational and scientific icons. These include a large letter 'V', a globe, a microscope, a stack of books, a plus sign, a percentage sign, and a less-than sign.

3D Printing in the Classroom

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3D Printing

What is 3D Printing?

- Instead of printing on paper which is 2-dimensional, using a digital file and 3D printer, users can create any 3-dimensional figure they can imagine
- It allows students and teachers to create and print 3D objects that they can touch and feel



3D PRINTING

REVOLUTIONISING

the

CLASSROOM

Biology students can study cross-sections of hearts or other organs.



3D Printers have actually been around for about 25 years. Barriers like costs are breaking down, so they are now very affordable and easy to use.

3D Printing has caught the attention of educators who are looking into ways to incorporate it into the classroom.

Using 3D Printers in the classroom could mean:

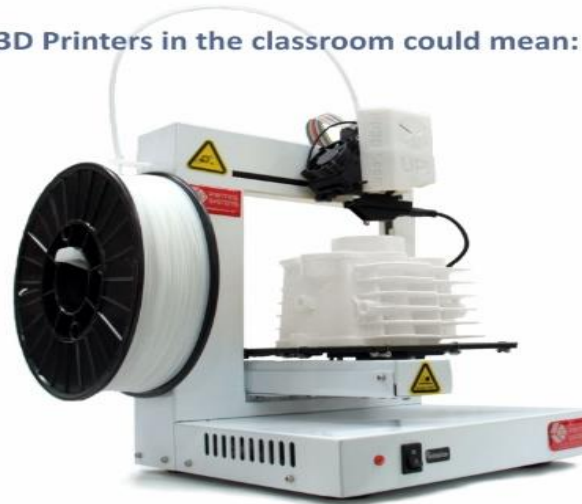
Chemistry students can print out complex molecules to study.



Engineering students can print modified car or robot parts.



Geography students can print out topography, population or demographics of an area.



Graphic design students can create prototypes of product designs



Food Technology students can design molds and cookie cutter templates



Design and Engineering students can make prototypes of their creations.



Architectural students can print new or existing designs.



History classes can print artifacts for closer examination

How does this technology support the technology vision for Dalton Middle School?

- The vision states that technology will connect students to more engaging, authentic, and meaningful learning experiences
- 3D printing will allow students to be engaged as they work to design and create their own products or explore hands-on artifacts meant to make the learning more authentic and meaningful
- Innovation and inquiry are encouraged as students use 3D printing to test their ideas and reflect on their work to make it the best it can be

Objectives

- To increase student achievement by allowing them hands-on exploration of models and replicas of artifacts related to the content
- To encourage student-centered and inquiry-based learning experiences where students have control of the end product and the path taken to get there
- To encourage student creativity through authentic problem-based learning situations

Key Benefits

- Students can imagine and create models of their ideas to show their learning
- Teachers can print 3D artifacts and manipulatives for students to explore during the learning process

Target Population

- 3D printing can be used in all grade levels from Pre-K thru 12th
 - For examples, check out:
 - [LeapFrog 3D Printing for Education](#)
 - [Shapeways](#)
- STEM classrooms designing and creating visuals and/or models
- Teachers wanting to create manipulatives or hands-on artifacts to share with students to enhance learning

Equipment & Software

- When purchasing a 3D printer it is important to keep in mind the size needed. They are easily purchased in a variety of sizes depending on the size of product printed
- The 3D printer should come with an accompanying 3D software creation tool
- 3D files can also be downloaded or purchased on the Internet at websites such as [Shapeways.com](https://shapeways.com)

Equipment & Software

- A computer with a fast processor, appropriate external connecting cables to the printer, and a high level of running memory (RAM) would be needed to handle the graphics used to create the designs printed
- Filament needed for printing would need to be purchased as it comes in many colors

Technical Support

- Training will be needed for technology technicians in order to service the printer as needed
- Training for media specialists, and teachers in the building who will serve as experts on the tool for other teachers

Limitations

- 3D printers can only print items based on the size of the machine – the larger the object and machine the higher the price
- Replenishing the printing filament can be costly if used effectively
- The user will have to go to a computer with the installed software to design a 3D object and prepare it to print

The Cost of the Technology

- Depending on size, 3D printers can cost between \$500 - \$7,000
 - The cost of the printer increases as the size increases
- 3D Printer Filament - \$25 - \$50 per roll, per color
- Computer to connect the 3D printer and run the installed software - \$2,500

Potential Funding Sources

- Local PTA grants from Cougar Carnival
- Local business sponsorship
- Local Dalton Education Foundation (DEF) grant

How does this technology help meet content standards?

- 3D printing can be used by students to see their ideas come to life and test out designs they have created
- 3D printing allows teachers to create manipulatives to be used in their classroom
 - For example:
 - Science teachers could create a model of a plant cell and allow students to label parts
 - Social Studies teachers could create a replica of influential people throughout history to show how cultures have over time
 - Math teachers could use mathematical principals to create a bridge to withstand a certain amount of weight
 - Literacy teachers could create 3D models of what they think a character looks like based on descriptions and context clues provided in the text

How does this technology help meet technology standards?

- 3D printing allows students to use creativity in their use of technology (NETS-S 1)
- Students and teachers must use technology software to create or tweak 3D files to fit the object they are planning to print (NETS-S 1 & 4)
- The idea of 3D printing opens the door to talk about copyright issues and what is legal and ethical to reproduce and why (NETS-S 5)
- Troubleshooting of software and the printer will be needed occasionally (NETS-S 6)

How does this technology promote Project-Based Learning?

- 3D printing allows students working through real-life problem scenarios to create a possible solution, create it using a 3D model, test the solution for plausibility and make adjustments as needed before the final product is created
- 3D printing can be used to create prototypes and exemplars for student work
- 3D printing allows students to be innovative and create something completely original to fill a potential need

How could this technology be used to differentiate learning?

- Teachers can create different levels of manipulatives to meet the specific needs of the learners
- Students can design objects based on their levels
- 3D printing helps to visualize complex ideas and content for tactile learners
- 3D printing can be used to create individualized assistive technologies to meet the needs of students with disabilities

How could this technology promote communication?

- 3D printing can be used to transfer ideas to real objects or models to communicate content
- 3D printing can be used by teachers or administrators to create models representing renovations or changes to a space with the school community

Implementation Plan

- To best introduce and implement this emerging technology, the Cyclical Process Framework would be utilized. By focusing on a small core group of teachers who are interested in learning about and using this new technology and will later serve as experts for their colleagues, it will be easier to determine the effectiveness of utilizing this tool in the classroom.
- As teachers have positive experiences with the 3D printer, other teachers will become interested in learning about the technology and want to find their own ways to incorporate it in their classes.
- Starting with a smaller group allows the school and technology department time to get the issues resolved and create a framework and process for how the technology can and should be used school wide.

Implementation Plan, cont'd

- The beginning group of teachers (10 or less), media specialist, and technology personnel will receive training on the equipment and software from outside trainers.
- Once the team feels as though the new technology is beneficial for the school they will begin training teachers in small groups. During these sessions teachers would be able to see real products that have been created using the 3D printer and a basic overview of how to use the equipment and software. Individual training would also be available on a needs basis.
- The goal would be for each teacher to at least have an orientation to the 3D printer by the end of the first school year.

Evaluation of Research

- The research for 3D printing in education is overwhelmingly positive. It allows “passive consumers to become active creators” according to an article posted by the EdTech Team.
- A case study completed at a high school in Minnesota found that using a 3D printer allowed students and teachers to be more creative and explore new possibilities within their science and engineering courses. The school has created a pathway revolving around this technology to prepare them for life after graduation.
- Southview Middle School reported that using 3D printing in their school created enthusiasm for learning and even encouraged parents to get involved so they could learn about this new tool that captured their child’s attention.

Evaluation of Research

- Trudi Lawless reported the discovery of how integrating a 3D printer in her STEM classroom has revolutionized the way she teaches. The students have the ability to interact with the technology instead of just hear about how it works. Lawless has also been able to make solid connections with how this technology is used in the real-world to hook her students' interest.

Reflection

As I tried to decide which emerging technology to evaluate I was driven by my work this year to encourage students to take ownership of their learning and become passionate about something. It was a wonderful experience to see students become empowered and make their thoughts and dreams come to life. 3D printing is something that I see as a natural extension of the work my students have done so that they can create prototypes and models of their innovations and passions. While 3D printing has been available prior to this year, this is the first year that the pricing and funding seems realistic for a school setting. I was so impressed at the large variety of products that a 3D printer can create and the genuine infinite possibilities that are now possible thanks to this emerging technology.

Reflection, cont'd

When I have thought about 3D printing in the past, it has been in the realm of high school engineering classes and STEM classes in the middle school. As I began sifting through the research and suggestions of how 3D printing can be used in the classroom I found myself continually thinking of more and more great ways that it could be used in my life science classroom. As I move forward in my professional career I am looking to create a grant proposal using the research from this evaluation to purchase this emerging technology for my school and classroom. In addition, I also am excited to use my resources in the technology world to continue learning about, evaluating, and hopefully implementing emerging technologies since they are ever evolving.

Resources

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