

# 3D Printing

Kate Hartig

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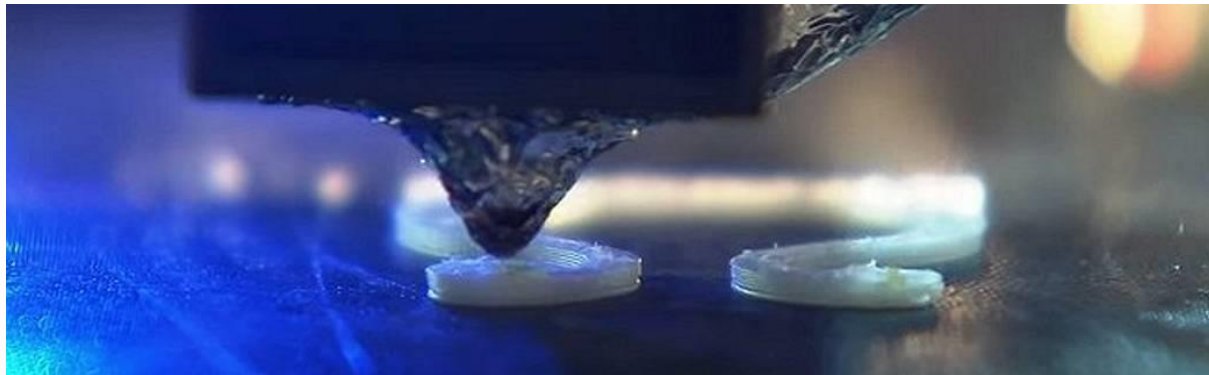
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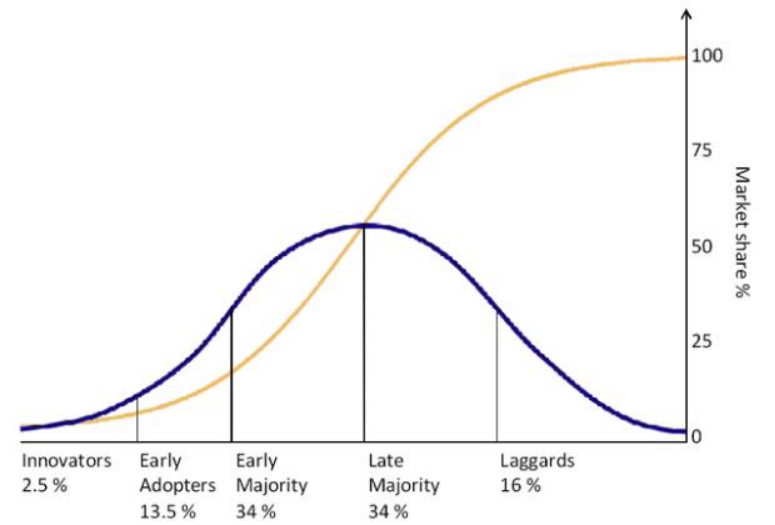
# What is 3D printing?

<https://youtu.be/UCI7BgLrk-4?t=31>

(3DPrinting.com, 2016).

# What is late-stage early adoption?

It describes the consumer market around new technology. The “consumer 3D printer marketplace is becoming crowded, and online and local 3D printing centers that users can send designs for professional printing are becoming more and more common.” (“An Introduction to 3D Printing,” 2013)

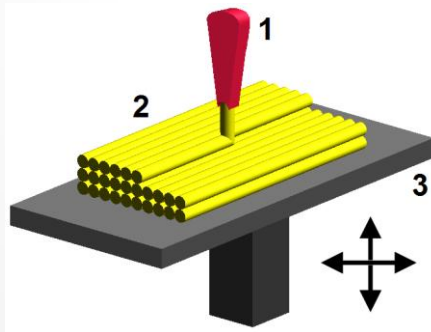


For more on the terminology see: [The Five customer segments of technology adoption](#) ("The 5 Customer Segments," n.d.)

# The NMC Horizon Report: 2015 K-12 Edition

Describes 3D printers as rapid prototype devices that construct physical objects from ... modeling software. Printers build the object by a layering process using materials such as plastic, wood, or metal. There may be some detail, moving parts, color in the rendering.

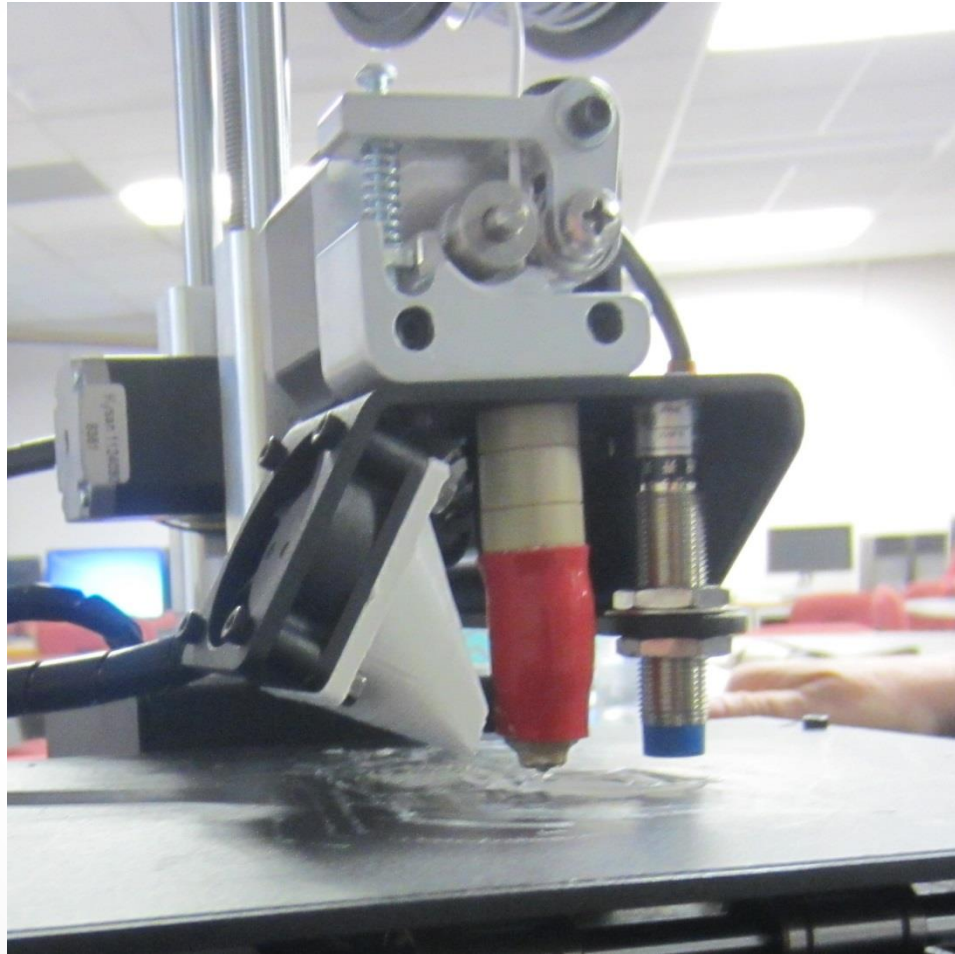
(NMC horizon report: 2015 K-12, 2015)



At left : Fused deposition modeling (FDM): 1. nozzle ejecting molten material, 2. deposited material (modeled part), 3. controlled movable table. (Zureks, 2016)



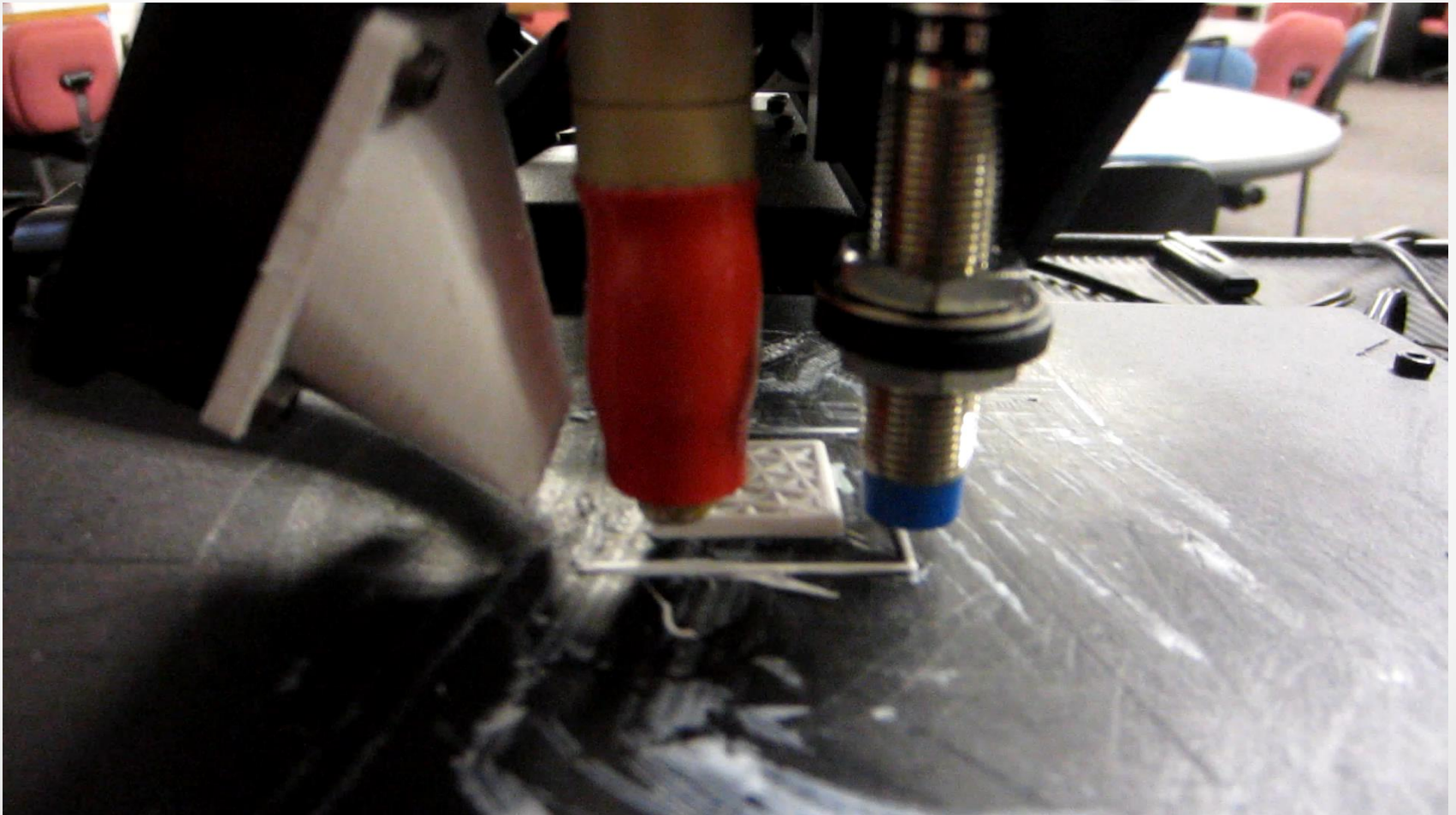
# 3D Printerbot Simple Metal in the Resource Library



# TU 3D Printer



# Printer working





# The NMC Horizon Report: 2015 Higher Education Edition

## Important Developments in Educational Technology for Higher Education

35

- > **Internet technologies** include techniques and essential infrastructure that help to make the technologies underlying how we interact with the network more transparent, less obtrusive, and easier to use.
- > **Learning technologies** include both tools and resources developed expressly for the education sector, as well as pathways of development that may include tools adapted from other purposes that are matched with strategies to make them useful for learning. These include technologies that are changing the landscape of learning, whether formal or informal, by making it more accessible and personalized.
- > **Social media technologies** could have been subsumed under the consumer technology category, but they have become so ever-present and so widely used in every part of society that they have been elevated to their own category. As well established as social media is, it continues to evolve at a rapid pace, with new ideas, tools, and developments coming online constantly.

- > **Visualization technologies** run the gamut from simple infographics to complex forms of visual data analysis. What they have in common is that they tap the brain's inherent ability to rapidly process visual information, identify patterns, and sense order in complex situations. These technologies are a growing cluster of tools and processes for mining large data sets, exploring dynamic processes, and generally making the complex simple.

The following pages provide a discussion of the six technologies highlighted by the 2015 Higher Education Expert Panel, who agree that they have the potential to foster real changes in education, particularly in the development of progressive pedagogies and learning strategies; the organization of teachers' work; and the arrangement and delivery of content. As such, each section includes an overview of the technology; a discussion of its relevance to teaching, learning, or creative inquiry; and curated project examples and recommendations for further reading.

### Consumer Technologies

- > 3D Video
- > Drones
- > Electronic Publishing
- > Mobile Apps
- > Quantified Self
- > Tablet Computing
- > Telepresence
- > Wearable Technology

### Digital Strategies

- > Bring Your Own Device (BYOD)
- > Flipped Classroom
- > Games and Gamification
- > Location Intelligence
- > Makerspaces
- > Preservation/Conservation Technologies

### Internet Technologies

- > Cloud Computing
- > The Internet of Things
- > Real-Time Translation
- > Semantic Applications
- > Single Sign-On
- > Syndication Tools

### Learning Technologies

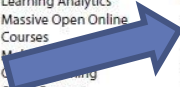
- > Badges/Microcredit
- > Learning Analytics
- > Massive Open Online Courses
- > Mobile Learning
- > Open Learning
- > Open Content
- > Open Licensing
- > Virtual and Remote Laboratories

### Social Media Technologies

- > Collaborative Environments
- > Collective Intelligence
- > Crowdfunding
- > Crowdsourcing
- > Digital Identity
- > Social Networks
- > Tacit Intelligence

### Visualization Technologies

- > 3D Printing/Rapid Prototyping
- > Augmented Reality
- > Information Visualization
- > Visual Data Analysis
- > Volumetric and Holographic Displays



# I see and I remember

Making knowledge new and your own.

Evaluating what works and what doesn't.

Analyzing new solutions with play and experiment.

Applying knowledge to solve existing problems.

Seeing questions in a new way by tactile.

Opening up to new information by visual experiences.



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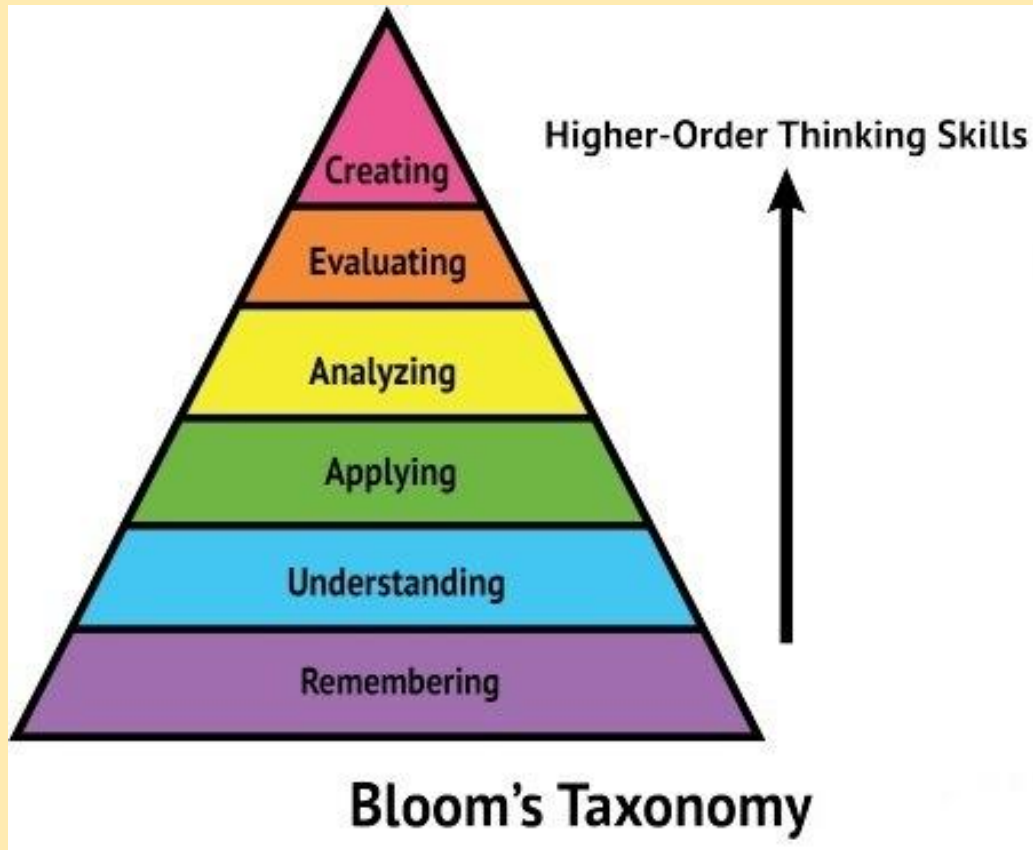
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# Knowledge



And for creating new knowledge

For evaluating efforts

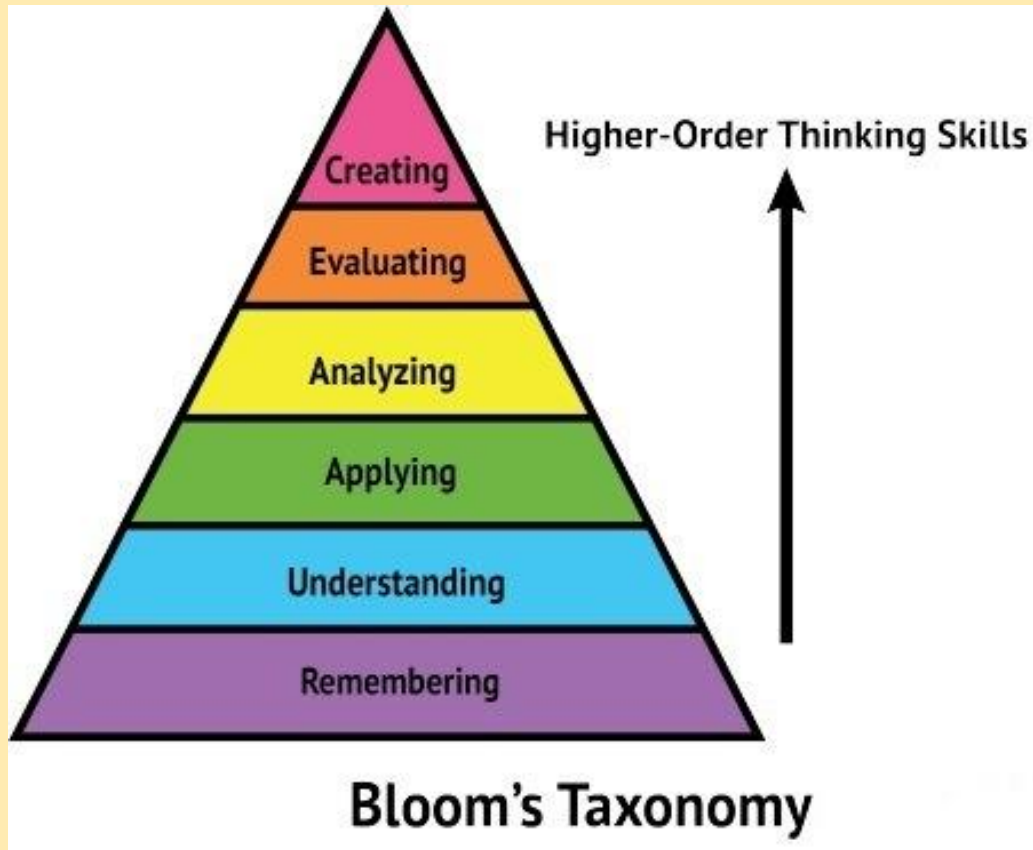
For analyzing and experimenting

For applying new information in  
a new way

For understanding

Learning by new visual  
experiences

# Comprehension



And for creating new knowledge

For evaluating efforts

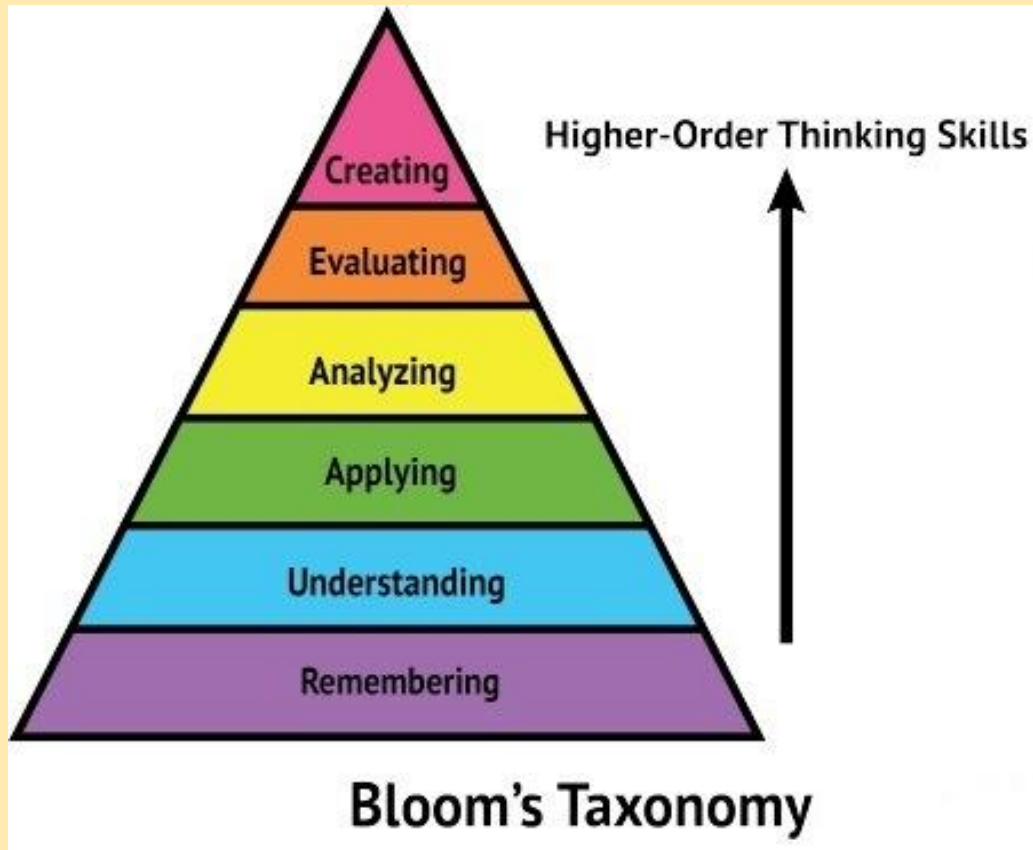
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# Application



And for creating new knowledge

For evaluating efforts

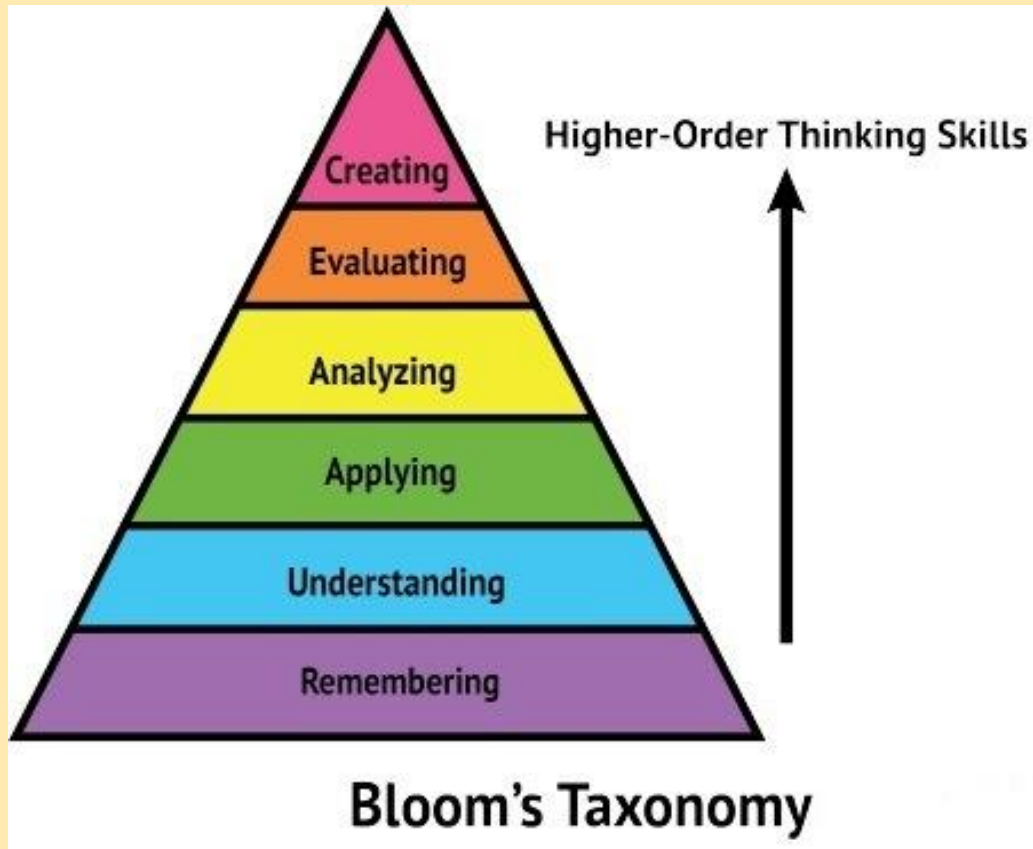
For analyzing and experimenting

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# Analysis



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For evaluating efforts

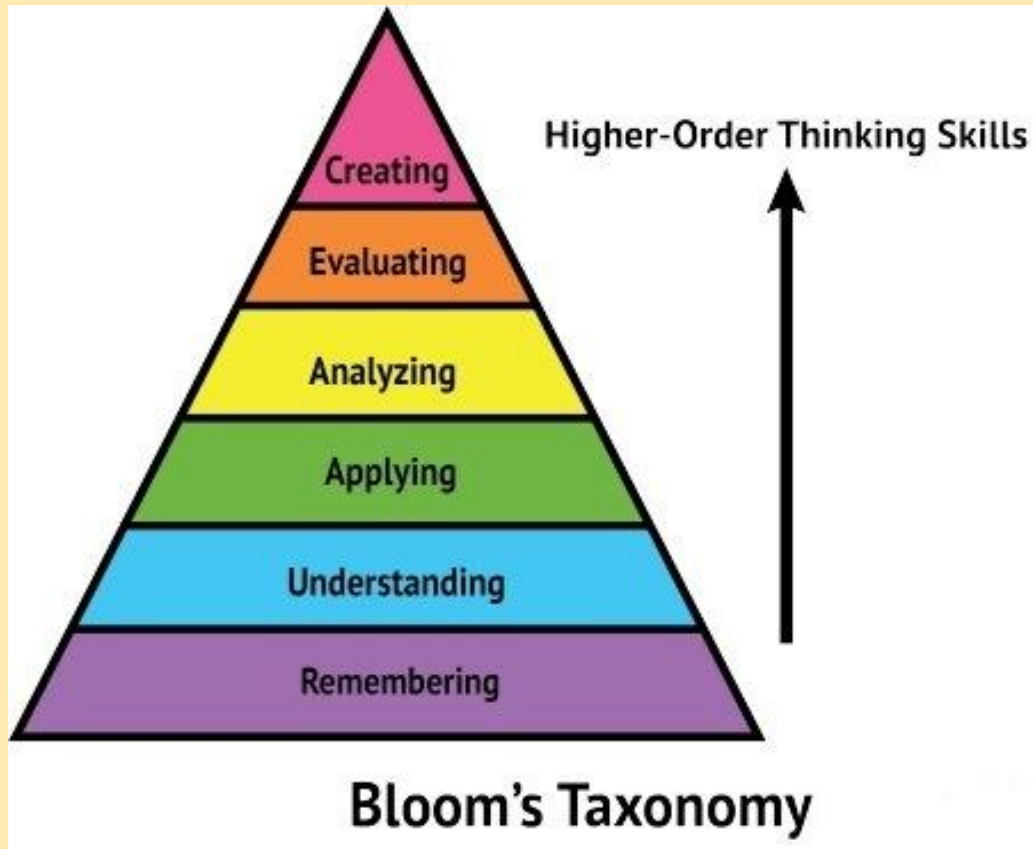
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# Evaluation



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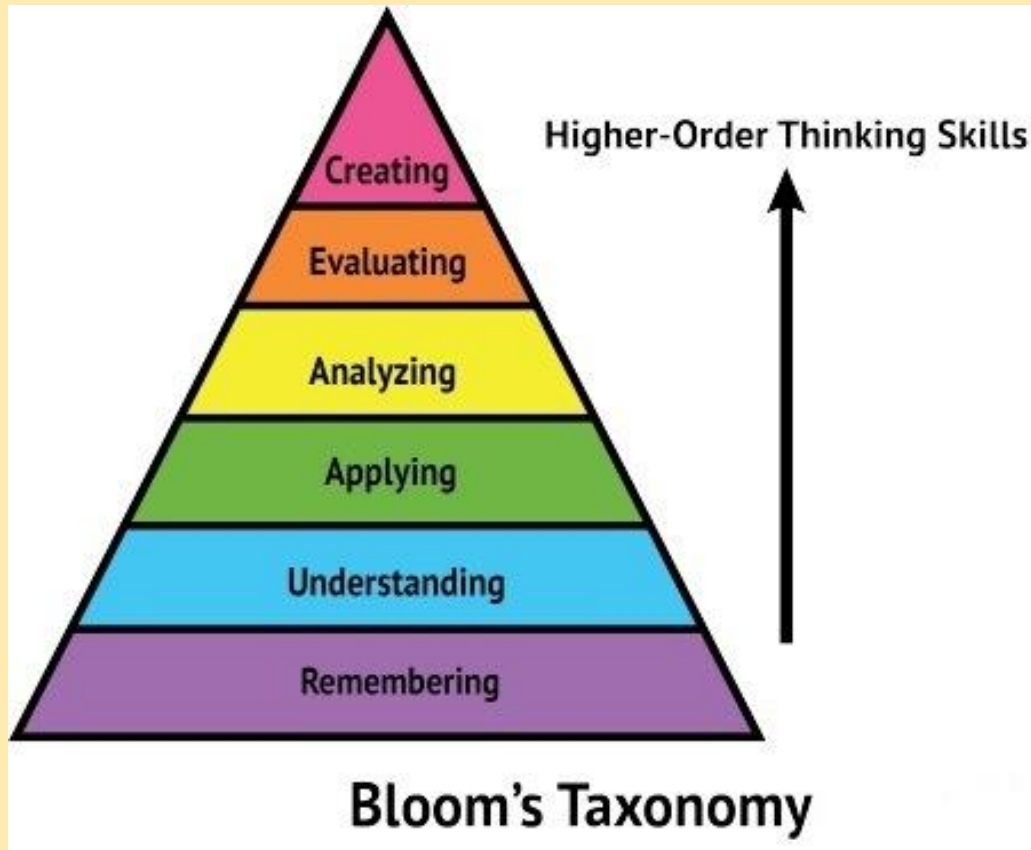
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# Evaluation



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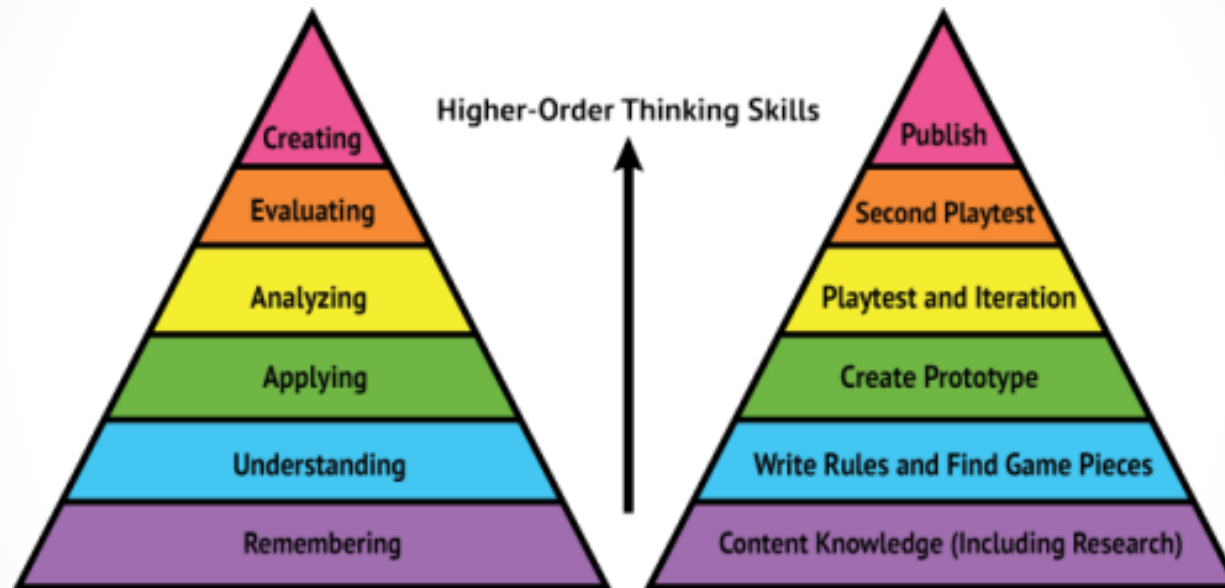
For learning by new visual  
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# 3D printing allows for visualization

And takes it steps further.

# Blooms Taxonomy compared to game development

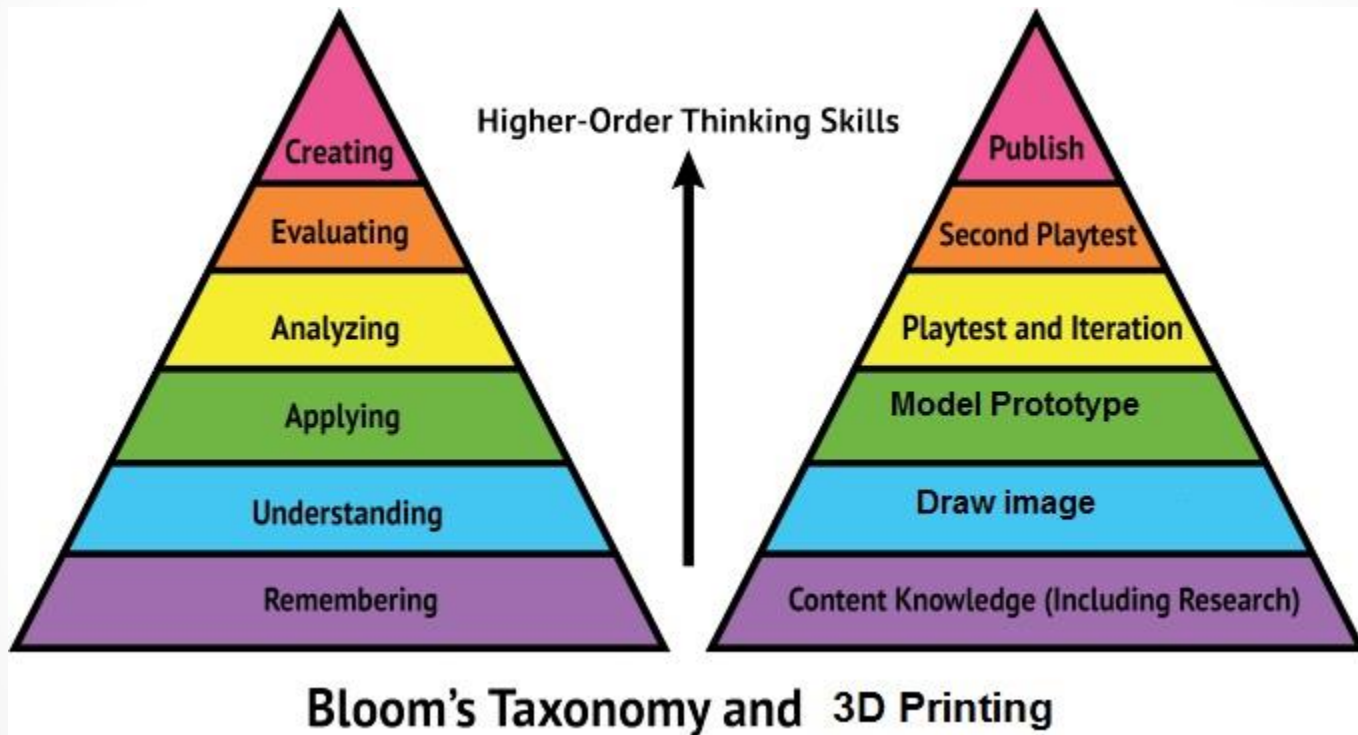


**Bloom's Taxonomy and Game Design**

2010-2016 Zulama blog; Games and Bloom's Taxonomy by B. Vaillancourt.

<http://zulama.com/education-trends/games-blooms-taxonomy/#.VsoFMOYRrSg>

# Blooms Taxonomy compared to 3D printing



# How is 3D printing significant in K-12 education?

“Educators recognize the importance of hands-on models,” which are costly, fragile, and as a result underused. Three D printing enables schools to make and customize models. (Lipson, [2006])

One educator suggests that textbook companies could include files for models within each chapter to increase understanding and experience.  
(Krassenstein, 2014)

In the hands of the teacher, it can allow for tactile example and hands on learning.

“Creating compelling presentations is also becoming more important to scientists and researchers at universities, as they are increasingly expected to be able to communicate their findings and connect with the public.” (NMC Horizon report: 2015 higher education, p.28)

# Regarding Teachers

The technology can be used as a motivator, a way for a teacher to engage students, and as a way to help students see the value to their education.

(Peterson, T. , 2015)

In the hands of the student, it can allow new concept development, understanding, manipulation, and product design.

# I do and I understand





# Regarding Students

One student found out about 3D printing by going to a FabLab, a Maker lab in her community. She worked to bring the technology to her school. The technology's value is to help students to become creative with technology.

(John, 2014)





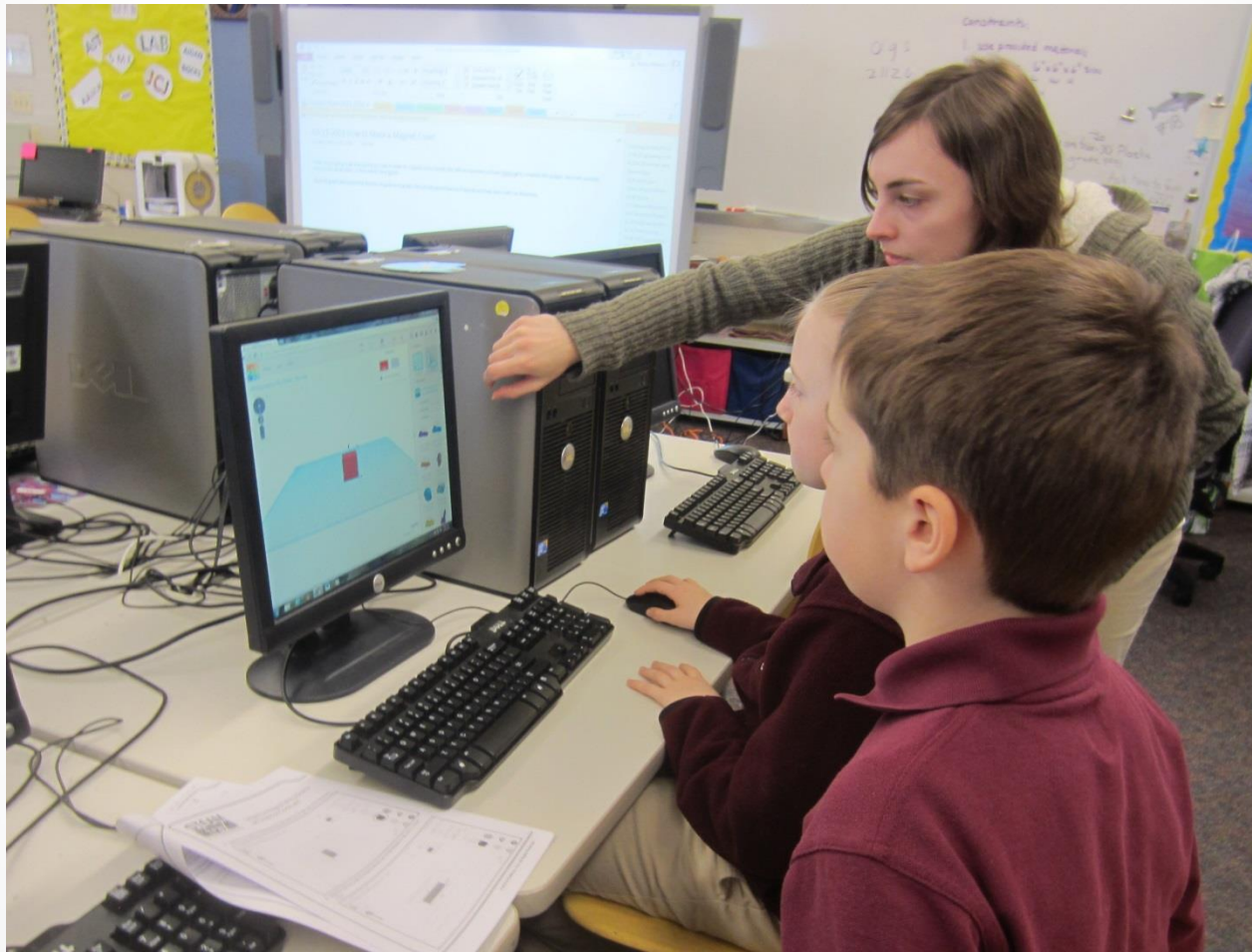
3D printing “lets kids [of all ages] learn how to endure adversity and persist in solving problems.”

(Schaffhauser, 2013)

3D printing will certainly spur on new inventions, simply because inventors now have a way to test out their ideas with tangible models and prototypes.

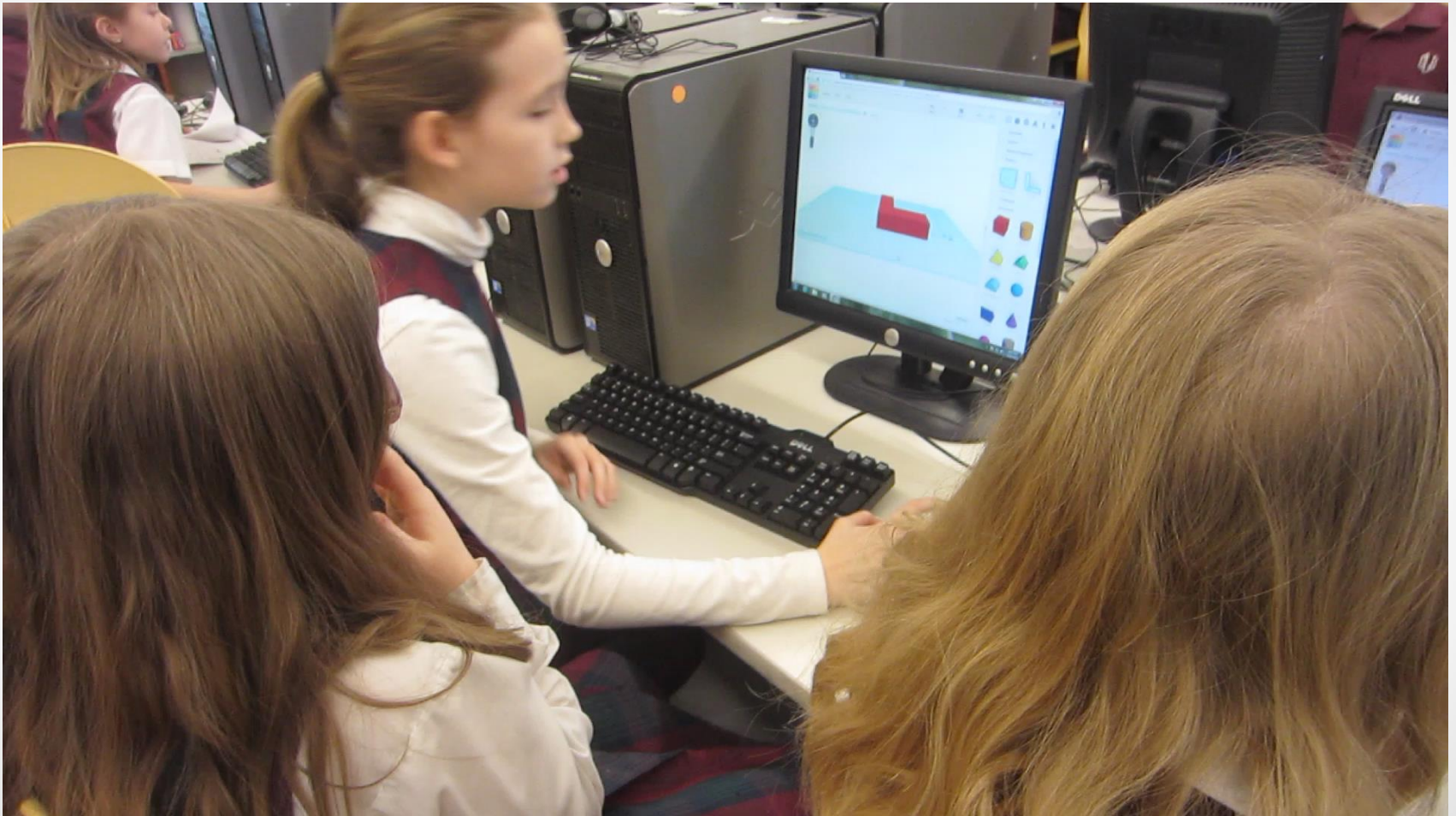
(Krassenstein, 2014)

# In action



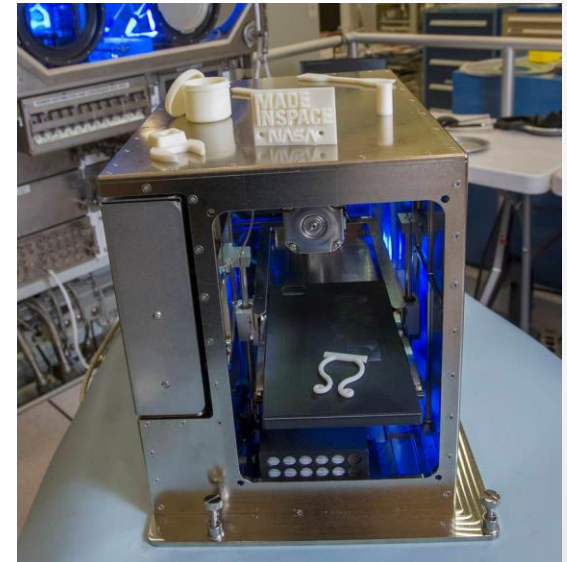
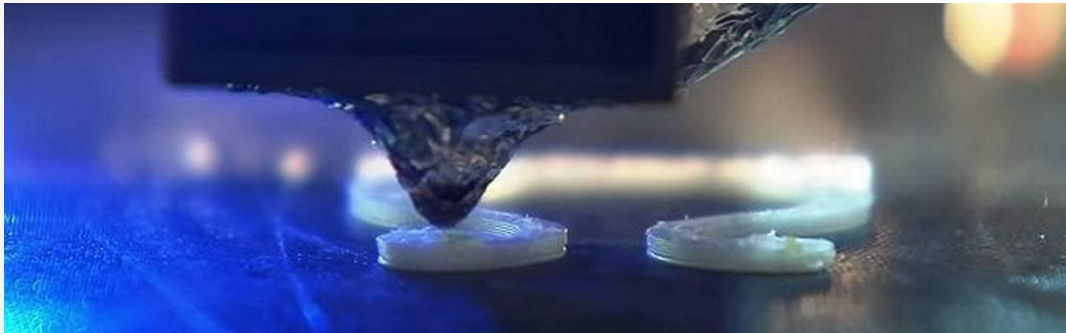


# In action, continued



# 3D in the Community

Outside of education, there are a variety of 3D uses in industry, scientific research, and gaming. So awareness and ease of use of this technology prepares students for their future.



# 3D in the Community





# Makerbot and Robohand

<https://youtu.be/WT3772yhr0o?t=536>

Mechanical hand and transfer to help others clip

Full url: <https://youtu.be/WT3772yhr0o>

# Preparing for industry

Emma did not have use of her arms from birth.

Her parents were invited into a workshop to try out a stationary “Rex” that enabled her to move her arms

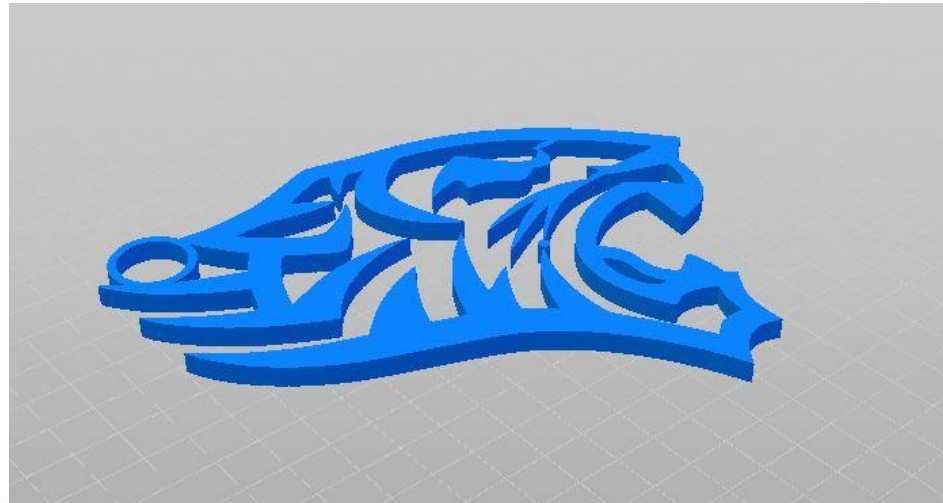
<https://youtu.be/WoZ2BgPVtA0?t=71>

(Stratasys Ltd. 2012)

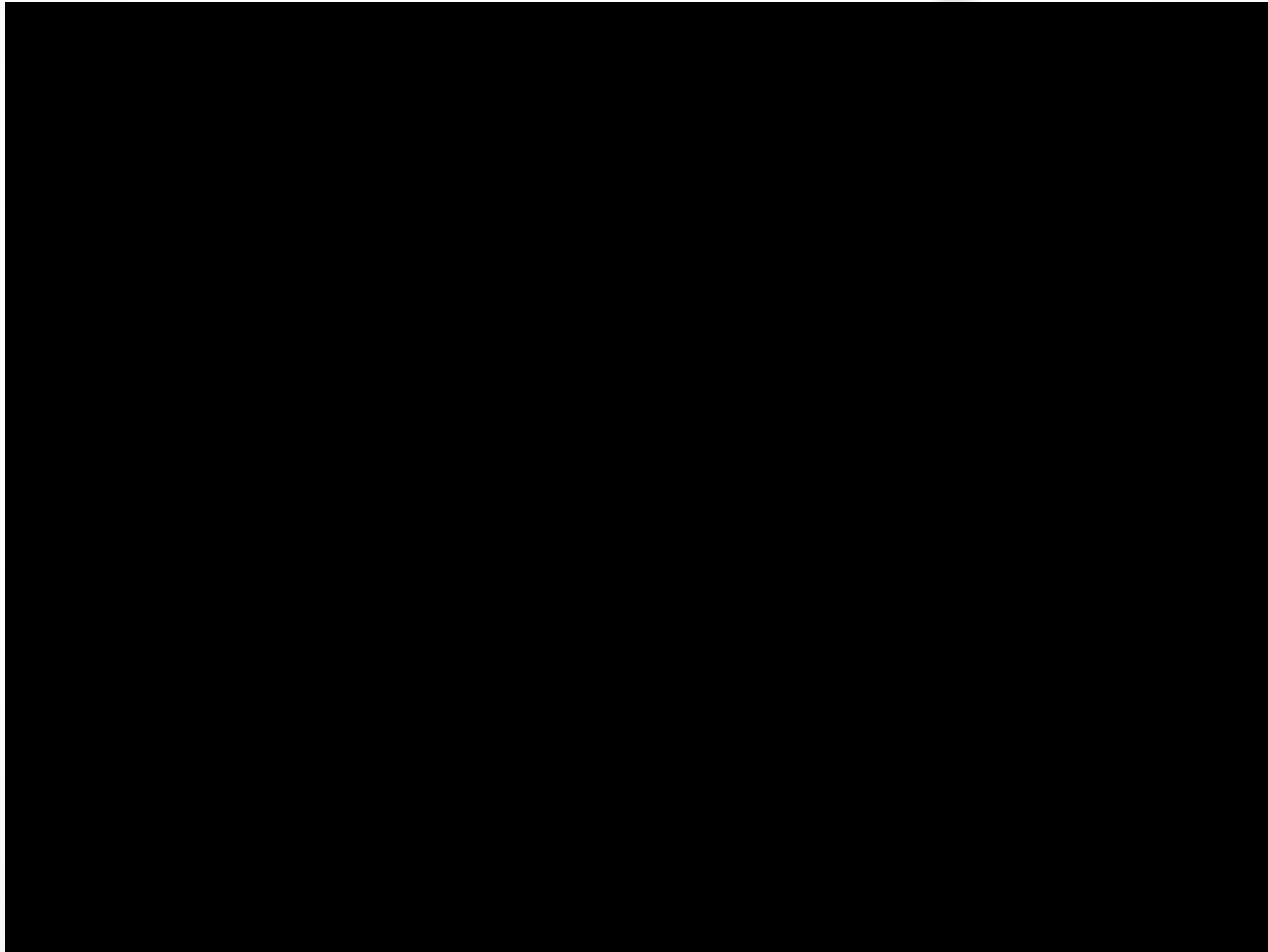
Stratasys Ltd. (2012, August 1). *3D-Printed "Magic Arms"* [Video file]. Retrieved from <https://www.youtube.com/watch?v=WoZ2BgPVtA0&feature=youtu.be>



Software can take a 2D image and create an electronic file for the 3D model



# Visualizing



Shall we try?

# Relevance for Teaching, Learning, or Creative Inquiry

It enables authentic learning

<http://www.cookiecaster.com/>



# Tinkercad



<https://www.tinkercad.com/>

# Future considerations

China is making strides to set up a 3D printer in every school and President Obama supports a similar endeavor in the United States. (Krassenstein, 2014)

A growing market for parts and model designs instead of products, shipped across the world, would reduce the carbon footprint. (Campbell, Williams, Ivanova, & Garrett, 2011)

Developing a model and using skin cells to grow small patches of skin for cosmetic testing, provides an alternative to testing on animals. (Rhodes, 2015)



# Constraints to broad use in education

Teachers need training in the devices. And they need to sift through the available software and find the best resources for educational use of the 3D printer.

“There are lots of resources for helping students print toys and novelties, but that’s not going to improve education,” [says educator Corey Kilbane, from William Penn Charter School (K-12) in Philadelphia. “We have to ask, what can we do with 3D printing that we couldn’t do otherwise? Could we hand kids Legos and do the same thing? If we ask and answer tough questions, 3D printing will be an increasingly valuable tool.” (Peterson, T. , 2015)



# Things that keep one up at night

Plastics used in 3D printers are ABS and PLA plastics. The first is used in Legos and Brita containers and safe as we know it. (Voorhies, 2014)  
PLA plastics are corn based replacing petroleum based components. (Scheer & Moss, 2008)

But adequate ventilation and handling should be taken for the printer to prevent exposure to fumes or small plastic particles. (Sher, 2015)



# More to explore

What research has been done on this trend?

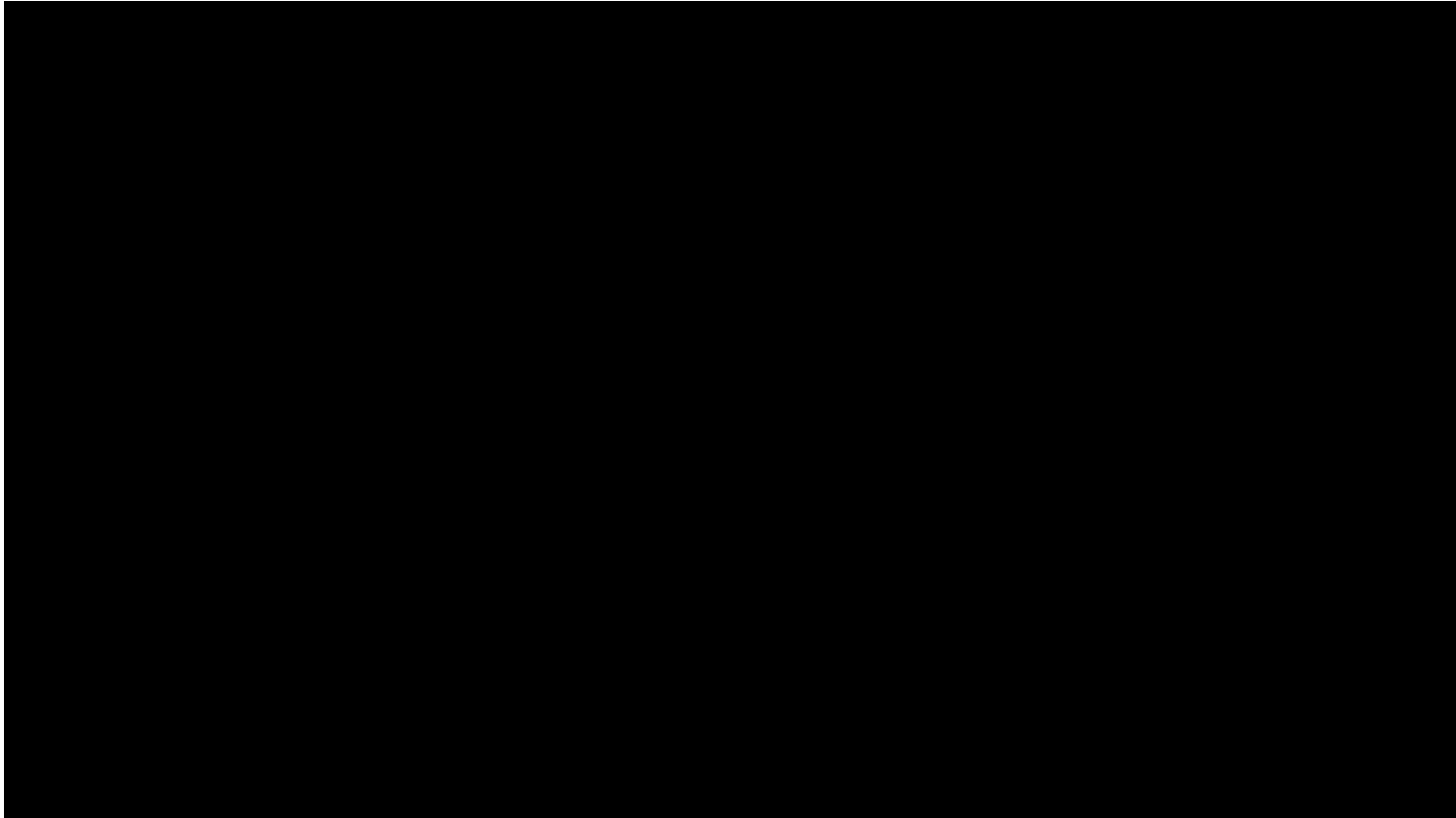
What research questions should we be asking?

Implications for teaching and learning, with consideration for those populations often underserved because of budget constraints (autistic, English Language Learners, economically disadvantaged)

And “if every history class had the ability to 3D print replicas of artifacts from a massive library of downloadable STL files. Every classroom would now have access to museum artifacts from the luxury of their own school. (Krassenstein, 2014).



# 3D Printing in a nutshell



The first part of the video briefly describes the 3D technology and issues involved, including acceptable use. (Stop video at “What is 3D Printing)

# One great educator shares resources

