

## Blending Innovation, Student Co-Learning, Entrepreneurship and Informal Education – **Innovation 5**

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## Origins of the Innovation 5 Concept

The convergence of three current streams in STEM and STEM education inspired the Innovation 5 concept

- The new technologies of additive manufacturing and rapid prototyping
- Growing emphasis on innovation and entrepreneurship in the community and in education
- The need to inspire, engage and retain students in STEM career pathways

## Additive Manufacturing

### What is additive manufacturing?



[www.kpi.com](http://www.kpi.com)

Additive manufacturing



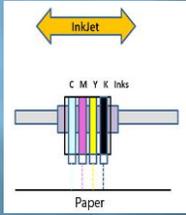
[www.stumthing.co.uk](http://www.stumthing.co.uk)

Conventional (subtractive) manufacturing

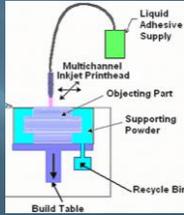


[www.turtoomfg.com](http://www.turtoomfg.com)

The most common form of 3d printing for additive manufacturing uses the same principle as the ink jet printer



<http://www.fdmjet.com/technology/>



Biomimetic Structured Porogen Freeform Fabrication System for Tissue Engineering Jack Zhou and Lin Lu DOI: 10.5772/21551

Additive manufacturing technologies are being rapidly embraced by industry



3D printed polymer implant approved by the FDA in 2013

<http://www.fda.gov/oc/2013/02/22/3d-printed-implant-approved-implant-to-receive-fda-approval.html>



3D printed jet engine part is 50% lighter

<http://3dprintingindustry.com/2013/05/31/can-3d-printed-jet-engine-parts-save-us-from-global-warming/>

Additive manufacturing today resembles the personal computer market of 35 years ago



Popular Electronics Magazine 1975

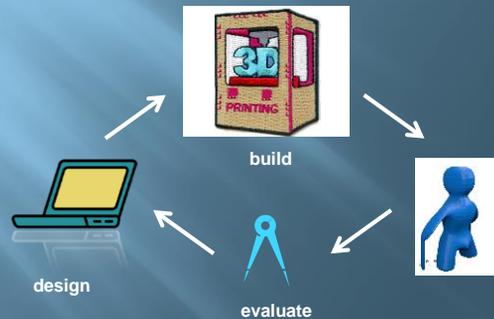
"Tinkerers with machines that turn binary digits into physical objects are pioneering a whole new way of making things- one that could rewrite the rules of manufacturing in much the same way that the PC laid waste to traditional computing."

The Economist Dec



Make Magazine, 2010

Rapid prototyping uses additive manufacturing and other computer-controlled technologies to speed the iterative design/build process



# Innovation and Entrepreneurship

## Innovation and entrepreneurship in the community and in education

The additive manufacturing/rapid prototyping technology has become the basis for a new culture – maker spaces where individuals and small businesses share tools and innovate for business or for personal interest.



ADX, Portland Oregon

<http://www.adxportland.com>



Fab Labs (international)

<http://www.fablabinternational.org/>



Maker Works, Ann Arbor MI

[www.maker-works.com](http://www.maker-works.com)

# Authentic STEM Experiences

## Hands-on science museums successfully engage younger visitors



Photos from 'NanoDay' at Impression 5 Science Center, Lansing

### Authentic STEM experiences for students

Design/build challenges are a key element of current informal education programming



Boston Museum of Science Design Challenges



San Francisco Exploratorium Tinkering Studio



Lansing Impression 5 Science Center Build Zone

### Authentic STEM experiences for students

Using additive manufacturing rapid prototyping engages students in inquiry-based hands-on learning that emphasizes STEM-relevant skills

Students as young as early elementary age are being introduced to these technologies.



3D Printer installed at Birkenshaw Primary School, UK Part of the Tinkering with Technology program to bring 3D printing to young elementary students.

[http://www.boro.ac.uk/service/publicity/news-releases/2012/168\\_3D-Printing.html](http://www.boro.ac.uk/service/publicity/news-releases/2012/168_3D-Printing.html)

However, most additive manufacturing/rapid prototyping facilities are relatively invisible within their communities

Spartan Innovations, East Lansing, MI



Lansing Makers Network, Lansing MI



MSU School of Engineering, East Lansing, MI



In order to democratize access, facilities are now being established in museums, libraries and even outdoors

Wanger Family FabLab Museum of Science and Industry Chicago



<http://www.msichicago.org/whats-here/fab-lab/>



Fayette Public Library

<http://fbf.org/creationlab>



WoeLab, Togo

<http://www.siliconfrica.com/democracy-of-technology-make-everybody-equal-in-front-of-new-technologies/>

Engaging young people past elementary school age (the major demographic in hands-on science museums) in STEM is a major national challenge

“Classroom approaches that engage students in “active learning” improve retention of information and critical thinking skills, compared with a sole reliance on lecturing, and increase persistence of students in STEM majors. “

*Engaging to Excel – A Report to the President from the President's Council of Advisors on Science and Technology*  
February 2012

One way to approach this is to offer older students opportunities for authentic participation

*There is a rapidly emerging consensus that the most successful museums of the future will be places to hang out, engage and contribute: museums that blur the boundaries between “back of the house” and the public side.*

*Demographic Transformation and the Future of Museums*  
Betty Farrell, Ph.D., Maria Medvedeva  
©2010 The AAM Press, ISBN 978-1-933253-19-0

## The Innovation 5 concept

## The Innovation 5 Concept

### Children

- Age-appropriate STEM activities revolving around design/build and basic rapid prototyping technologies
- Aspirational setting – see and interact with more advanced users

### Older students

- Meaningful participation in advanced activities
- Participation in facility operation/decision making
- Team opportunities with entrepreneurs

### Community Members

- Welcoming environment
- Low cost entry to rapid prototyping
- “On ramp to innovation”

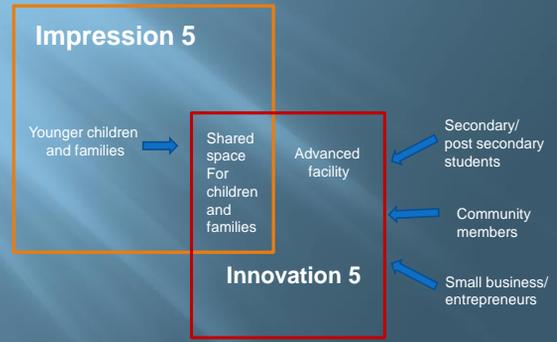
### Entrepreneurs

- Facilities for design/prototyping/building new products
- Students available to team on projects

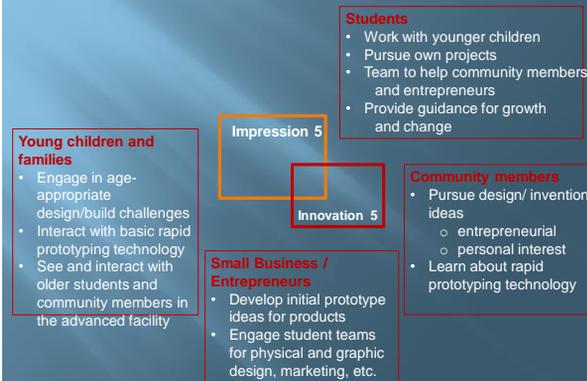
## Why Impression 5?

- Visibility – over 130,000 visitors per year
- Visitors have a young demographic that can be recruited to more advanced activities
- Impression 5 is located in the city of Lansing, Mi – a community with a high proportion of STEM-underrepresented populations
- Approximately 1/3 of Impression 5 visitors come from the City of Lansing
- Strong support from Impression 5 leadership

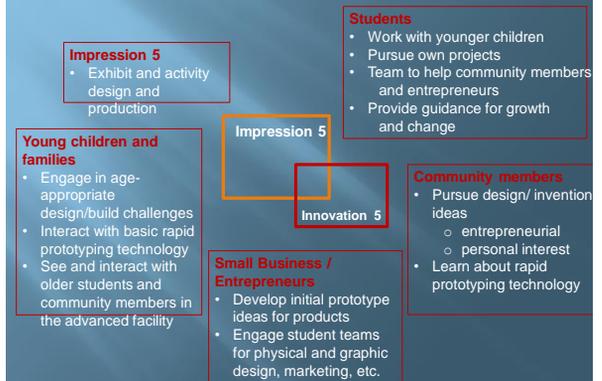
## Innovation 5 Conceptual Design



## How will Innovation 5 be used?



## How will Innovation 5 be used?



## Implementation

- Received seed funding from 3 local organizations
- Excellent positive feedback from all elements of community
- Survey of Impression 5 visitors revealed extremely strong interest
- Student enthusiasm and interest high
- 5 student interns are engaged in a co-learning project this summer
  - Space and equipment design
  - Social media
  - Funding sources
  - Educational objectives

## Sustainability

### Startup

- Grant funding
- Incremental equipment acquisition
- Student sweat equity

### Ongoing

- Revenue from users
- Subsidies for Lansing residents
- Student support through entrepreneurial teams
- Increased attendance and impact of Impression 5

### Dissemination

- Model may be first of its kind
- Should be possible to replicate elsewhere

## Innovation 5

*See innovators,  
Be an innovator!*

[www.innovation5.org](http://www.innovation5.org)

Thank you!