



NSF EAGER Maker Summit

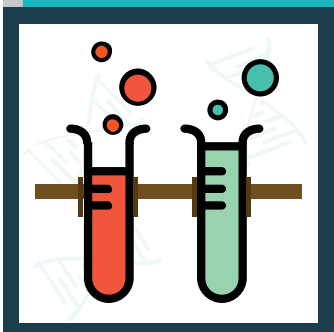
Charting the Future of Making in STEM Education

Held December 10-11, 2018

Alexandria, VA

What is a Maker Space?

Maker spaces typically include technology such as 3-D printers, laser cutters, computer design shop tools, and other electronics.



"A gathering place for tools, projects, mentors, and expertise."



(Graves et. al., 2006)

"Time, talk and tools" + creativity.



(John Dewey)



The Contemporary Maker Movement

1st Maker Class

Dr Neil Gershenfeld, MIT, started a class called How to Make (Almost) Anything, which sparked FabLabs.

1998

Before the branding, hobbyists have long been involved with ham radio & remote controlled airplanes.

2001

First Fab Lab

Started at MIT & was sponsored by NSF. Fab Labs then start popping up around the world.

Make Magazine Premiere

Publication helped brand a movement that built upon the American tradition of self-initiative, DIY & creativity.

2005

2006

1st MakerFaire

Held in San Francisco Bay Area. Hundreds are now held around the world each year.

Radio Shack & others provided components for "pre-makers" to build computers & other electronics, including founders of big dot-coms.

The Contemporary Maker Movement

1st White House Maker Faire

Also, June 18 is designated the National Day of Making

2014

2015

Week of Making

Designated by The White House as June 12-18.

Maker EOL

NATION OF MAKERS

2019 & beyond

Spaces for hobbyists & small-business entrepreneurs

Museums & other places for one-time experience.

Schools or free-standing spaces give extended experiences.

More than 2000+ maker, hacker, & fab labs in libraries, schools, hands-on museums & community spaces globally.



Maker Pedagogy

Constructivism in Formal & Informal Spaces

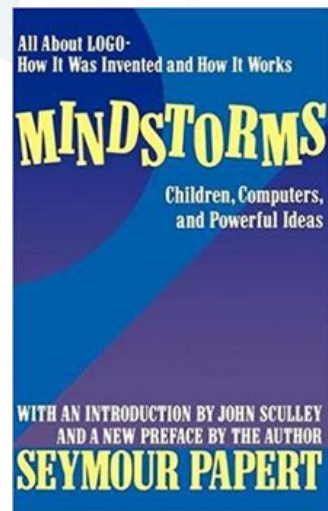


Maker pedagogy is rooted in philosophies such as **Rousseau's** ideas about the **nature of knowledge** & **Dewey's** ideas about **constructivism**.

They emphasize **meaning, active engagement, collaboration** and **child-centered hands-on experiences** in the world to drive learning.



Also extends to **constructionism** which emphasizes **student-centered learning that involves the use of materials or tangible objects**.

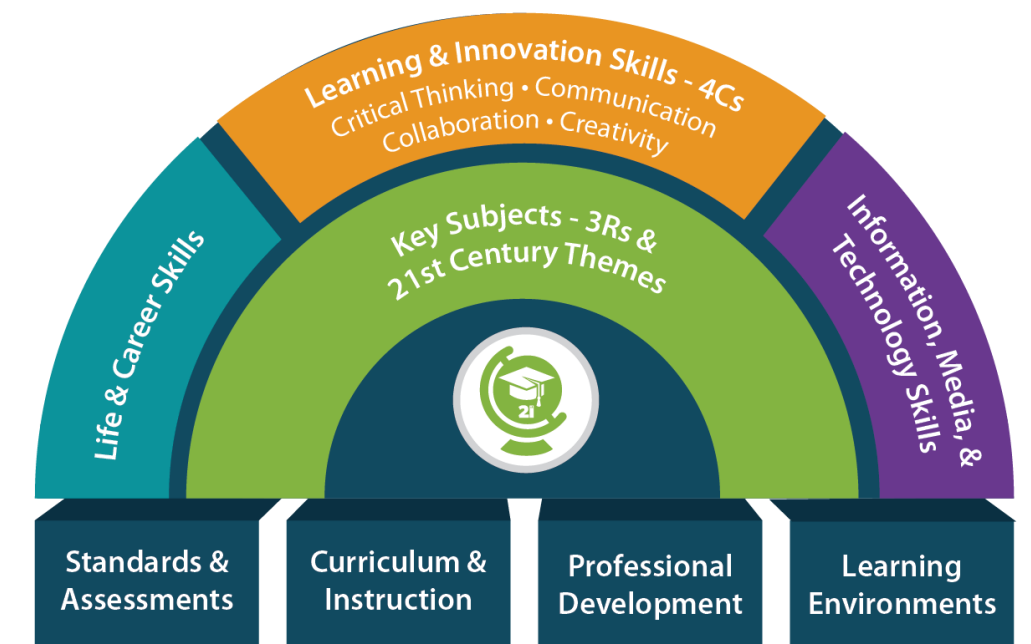


See Papert's (1993) book, *Mindstorms: Children, Computers and Powerful Ideas*

Ex: problem or project-based learning (PBL)

Schools begin to **embrace interest-driven learning** as a way to build:

- student interest & creativity
- STEM knowledge,
- STEM **self-efficacy**,
- design thinking,
- collaboration,
- & other **21st Century Skills**.

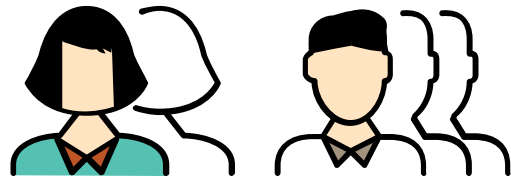




Impacting Communities in 28 States

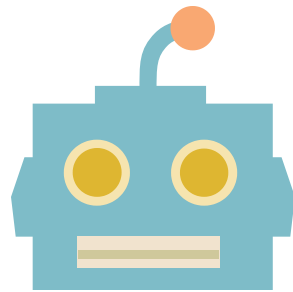


with innovative technologies & maker projects such as:



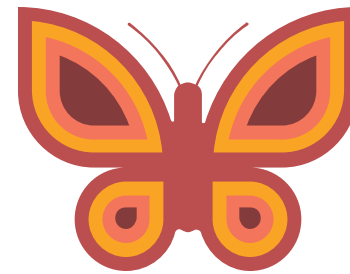
16 Workforce development & STEM pathways

Ex: Veteran Maker Workshop



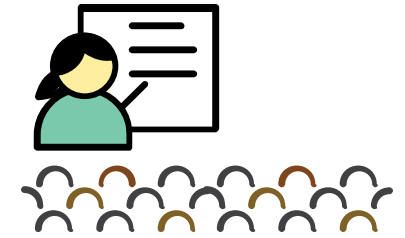
1 Robotics

Ex: Rural library makerspace with robotic telepresence mentors.



1 Nano-Makerspace

Ex: Microscale structures on butterfly wings.



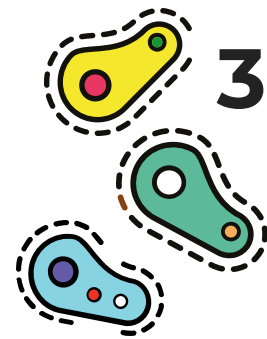
8 PD/Teacher prep

EX: Immersive MakerSTEM Lab experience to teach content & pedagogy to pre-service educators.



4 VR/AR

Ex: See the flow of electrons in a project you are building.



3 Bio maker spaces

Ex: Build genetic circuits to modify microorganisms.



6 Mobile maker spaces

Ex: Support learning & well-being in a children's hospital.

Five Summit Themes

Co-created through collaboration between NSF, EDC/STELAR, and PI's who volunteered for the planning committee.



Broadening Participation



Partnerships



Process & Pedagogy



Research & Evaluation



Workforce Development

Goals of the Summit



Connect PIs with colleagues to share ideas and resources, and discuss potential collaborations

Charting the Future of Making STEM Education

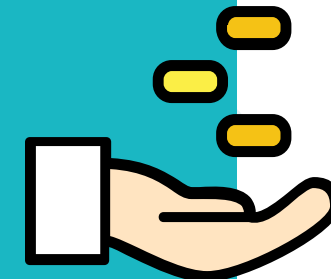
Identify current issues in the Maker movement with respect to education.



Identify important research issues and trends.



Discuss NSF's investments in the Maker movement.



Recommend future directions for NSF research and development to address challenges.



Summit Format

Almost entirely participatory, with a few plenary sessions.

Monday, December 10 *(Plenary sessions in blue will be recorded)*

7:30	8:30	Registration and Breakfast	Pre-function
8:30	9:00	Welcome and NSF opening remarks: Karen Marrongelle, Assistant Director of Education & Human Resources Directorate, NSF	Plenary
9:00	10:00	State of the State on Maker Education: Andrew Coy, Digital Harbor Foundation	Plenary
10:00	10:30	Collaboration Break	Pre-function
10:30	11:45	Synthesis Sessions: Round 1	
		Partnerships	Alexandria
		Research and Evaluation	Mt. Vernon
		Workforce Development	Potomac
12:00	1:00	Lunch and Table Discussions	Lunch room
1:15	2:30	Synthesis Sessions: Round 2	
		Broadening Participation	Alexandria
		Process and Pedagogy	Mt. Vernon
		Workforce Development	Potomac
2:30	2:45	Collaboration Break	Pre-function
2:45	4:00	Synthesis Sessions: Round 3	
		Broadening Participation	Alexandria
		Process and Pedagogy	Mt. Vernon
		Research and Evaluation	Potomac
4:00	4:15	Collaboration break	Pre-function
4:15	5:00	Synthesis Sessions: Summary and Reflection Activity	Plenary
5:00	5:30	Project Expo Set-up	Ballroom
5:30	7:00	Project Expo	Ballroom
7:00		Group dinners (self-pay)	

Tuesday, December 11 *(Plenary Sessions in blue will be recorded)*

7:30	8:30	Breakfast	Pre-function
8:30	9:30	Welcome and Walkthrough of Day 2 Report out of Day 1 Synthesis Sessions	Plenary
9:30	10:30	Panel: Innovations, Challenges and the Future of Making <ul style="list-style-type: none"> Liza Manfred, KID Museum Erick Jones, University of Texas, Arlington Andee Rubin, TERC Monya Ruffin, National Science Foundation 	Plenary
10:30	11:00	Envisioning Group Selection and Collaboration Break	Pre-function
11:00	12:15	Envisioning Group Sessions	Ballroom
12:30	1:30	Lunch and Envisioning Q&A	Lunch room
1:45	3:00	Envisioning Group Sessions	Ballroom
3:00	3:15	Collaboration Break	Pre-function
3:15	4:15	National Science Foundation Panel: Envisioning Groups Report to NSF <ul style="list-style-type: none"> Evan Heit, Director, Division of Research on Learning (DRL) Ellen McCallie, Program Director Robert Russell, Program Director 	Plenary
4:15	4:30	Close and Next Steps	Plenary

Maker Summit Outcomes

Visit the Maker Resource Library

A primary goal of the Summit was to compile a comprehensive bibliography of resources in the Maker field. Thank you to all who submitted resources!

Search the library on our website:

<http://stelar.edc.org/maker-resource-library>



Maker Summit Outcomes

A 5-part webinar series:

- reporting-out from the event,
- carrying forward the discussion,
- sharing ideas generated at the event,
- fostering further collaboration,
- and connecting with the broader maker community.

Register for the series, or each individual webinar.

https://edc.co1.qualtrics.com/jfe/form/SV_54JytTRamgtjR53



Workforce Development



Process & Pedagogy



Research & Evaluation



Broadening Participation



Partnerships



Webinar 1: Workforce Development



Discussed at the Summit:

- Understanding Need
 - skill sets related to jobs
 - location barriers
 - income limitations
 - financial goals
 - use of technology and manual tools
- Transition from maker to workforce sustainability
- Development of skills and collaboration, self-efficacy etc.
- Partnerships with business and industry
- Maker context for unique populations (e.g., veterans)
- Industry/academic/community partnerships
- Certification in IT & other areas
- Authentic experiences

View the slides & presentation here:

<http://stelar.edc.org/sites/stelar.edc.org/files/Presentation Slides.pdf>

<http://stelar.edc.org/videos/maker-webinar-workforce-development>

In the Webinar:


Make the Force be With You: Workforce Development through Making

Participants learned how their research in making is related to workforce development as a broader impact or as a direct intervention. This webinar examined how skills developed in making relate to imminent workforce needs. Presenters also discussed the need for longitudinal K-12 systemic preparation for STEM work and learning fields, and the connection between making and the future STEM workforce.

Presenters:

Anthony Dean, Batten College of Engineering and Technology
Gul Okudan Kremer and Richard Stone, Iowa State University

Date: Friday, April 12 from 12-1 pm ET



Webinar 2: Process & Pedagogy



Discussed at the Summit:

- Getting beyond 3D printing & technology
- Traditional schooling vs. making/learning
- What are the most important qualities of making and related pedagogy
- How to scale maker activities in school
- Developing pedagogical maker knowledge of teachers and informal educators
- Connecting making to curriculum & educational standards
- Equity & access in formal education

View the slides & presentation here:

http://stelar.edc.org/sites/stelar.edc.org/files/Final_Slidedeck.pdf

<http://stelar.edc.org/videos/stelar-webinar-maker-process-and-pedagogy>


In the Webinar:

This webinar will discuss how making looks like across different settings such as higher education, informal learning environments, and schools with high and low tech. The focus of the discussion will be pedagogical practices, practical challenges, and opportunities to broaden and sustain the participation of people with diverse backgrounds in Making. The presenters will highlight different aspect(s) of their projects relevant to the discussion.

Presenters:

Yasmin Kafai, University of Pennsylvania
Micah Lande, Arizona State University
Kristin Searle, Utah State University
Sinem Siyahhan, California State University San Marcos

Date: Friday, April 26 from 12-1 pm ET



Webinar 3: Research & Evaluation



Discussed at the Summit:

- What should be assessed
- Assessment in school vs maker spaces
- Standards of evidence
- No one-size-fits all methods
- Assessment skills, building capacity, protocols
- View of assessment as antithetical to making
- Researchers, practitioners, and value of research
- Relevant research methods for making activities
- Assessing voluntary maker activities

In the Webinar:

During this webinar we will examine the challenges in designing assessments and measuring cognitive and non-cognitive learning outcomes in a maker-based project.

Presenters:

Jennifer Albert, Citadel Military College of South Carolina
Cynthia Tananis, University of Pittsburgh
David Reider, Education Design

Date: Tuesday, April 30 from 1-2 pm ET

View the slides & presentation here:

http://stelar.edc.org/sites/stelar.edc.org/files/MakerWebinar_ResearchEvaluation.pdf

<http://stelar.edc.org/videos/stelar-webinar-maker-research-evaluation>

Webinar 4: Partnerships & Broadening Participation



Discussed at the Summit:

- Co-creation, co-design, responsive
- Community-driven needs, part of community ecosystem, building community capacity
- Grounded in community, community-driven
- Intergenerational, maker ethic at home
- Culturally sustaining approach, culturally responsive making
- Equitable making, attention issues involving gender, communities of color, persons with disabilities, LGBTQ
- Pathways/transition experiences for youthful participants to work

In the Webinar:

In this webinar, learn about individual and group strategies that can help to support your work - current and future. Presenters will highlight both Making Partnerships and Broadening Participation. Essential for most projects, strong partnerships are key to Making Partnerships because of the scope of outcomes and the distributed expertise present across individuals. In addition to supporting these partnerships, NSF is committed to broadening the participation of those underrepresented in STEM. The research community has an opportunity to address the challenges of understanding key differences of access versus equity, individual and local contexts, and co-creating research with communities. Discussions will include how the making community can work together to develop guiding principles for future research, and generate ideas on how projects can design for transformative change.

Presenters:

Bradley Barker and Dagen Valentine,
University of Nebraska-Lincoln
Dorothy Jones-Davis, Nation of Makers

Date: Tuesday, May 14 from 2-3 pm ET

View the slides & presentation here:

<http://stelar.edc.org/sites/stelar.edc.org/files/Partnerships%20and%20Broadening%20Participation.pdf>

<http://stelar.edc.org/videos/stelar-maker-webinar-partnerships-broadening-participation>



Webinar 5: An NSF Summary of the EAGER Maker Summit



In the Webinar:

NSF Making Partnerships

Join NSF Program Officer Robert Russell and Einstein Fellow Brenda Carpenter for this summative webinar on the 2018 EAGER Maker Summit. The presentation will provide an overview of NSF's commitment to making, review key highlights from the December meeting, and provide a recap of the previous four webinars in our series. Learn more about plans for continuing these conversations, and future opportunities for collaboration.

Presenters:

Robert Russell, NSF Program Officer and
Brenda Carpenter, Einstein Fellow

Date: Tuesday, May 21 from 2-3 pm ET

This event was supported by NSF grant # DRL-1614697. Any opinions, findings, and conclusions or recommendations expressed in this event are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

Resources

<http://stelar.edc.org/nsf-eager-maker-summit>

<https://www.asee.org/documents/papers-and-publications/papers/maker-summit-report.pdf>

<https://curiositycommons.wordpress.com/a-brief-history-of-makerspaces/>

https://s3.amazonaws.com/littleBits_pdfs/littleBits-GettingSmart-Infographic.pdf

<http://informalscience.org/>

<https://nationofmakers.us/resources.html>

<https://makered.org/resources/>

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STEM LEARNING AND RESEARCH CENTER



May 21, 2019

Bob Russell, NSF Program Officer
Brenda Carpenter, Einstein Fellow