

TINKERING RESOURCES

ARTICLES and COURSES

- Tinkering Fundamentals – Exploratorium’s Coursera Online Tinkering MOOC <https://www.coursera.org/course/tinkering>
- Exploratorium - Learning Dimensions Framework <http://bit.ly/1GhYuSw>
- Tinkering 101: Learning by Making! <http://bit.ly/1kq7TxI> A 2hr workshop for afterschool providers developed with Rachel Donegan, Educator at Montshire Museum

BOOKS and ARTICLES

- Democratizing the Maker Movement <http://huff.to/1O166L1> (featuring Erica Halverson)
- The Art of Tinkering by Karen Wilkinson and Mike Petrich, Exploratorium Co-Directors of the Tinkering Studio (PDF <http://bit.ly/1LnDrww>)
- Invent to Learn: Making, Tinkering and Engineering in the Classroom by Sylvia Libow Martinez
- Make: Tinkering: Kids Learn by Making Stuff by Curt Gabrielson
- Worlds of Making: Best Practices for Establishing a Makerspace for Your School by Laura Fleming
- Tinkerlab: A Hands-On Guide for Little Inventors by Rachele Doorley
- Making Makers: Kids, Tools, and the Future of Innovation By AnnMarie Thomas

PERIODICALS and WEBSITES

- MAKE Magazine: <http://makezine.com>
- Leah Buechley's web site: <http://leahbuechley.org>
- *Invent to Learn* by Sylvia Martinez and Gary Stager: <http://www.inventtolearn.com>
- The Tinkering Studio website and blog: <http://tinkering.exploratorium.edu>
- Engaging Learners in STEM Through Making and Tinkering <http://bit.ly/1MTfHTq> See article briefs below:

An Overview of Learning through Making and Tinkering

<http://relatingresearchtopractice.org/article/383>

Vossoughi and Bevan conducted a literature review of educational research on making and tinkering. Specifically they reviewed the historical roots of making, the emerging design principles that characterized tinkering and making programs, the pedagogical theories and practices that lead to supportive and collaborative learning environments, as well as the possibilities and tensions associated with equity-oriented teaching and learning. This brief provides a definition of tinkering and an overview of what is known about learning through tinkering.

How “Making” Projects can Promote Deep Learning

<http://relatingresearchtopractice.org/article/385>

Blikstein et al. review the history of science and engineering learning through fabrication and then discuss how to design fabrication spaces within school settings. The field of informal science education has embraced “making”

and design activities as a powerful approach to engaging learners, but questions remain about how such programs support deep STEM learning. This paper provides theoretical background and concrete cases that illuminate program design and implementation issues related to making.

Tinkering, Learning, and Equity in an Afterschool Setting

<http://relatingresearchtopractice.org/article/388>

This paper draws on ethnographic data to bring equity to the fore within discussions of tinkering and making. Vossoughi, Escudé, Kong & Hooper argue that equity lies in the “how” of teaching and learning through specific strategies for: designing making environments, using pedagogical language, integrating students’ cultural and intellectual histories, and expanding the meanings and purposes of STEM learning. The authors identify and exemplify emergent equity-oriented pedagogical principles within an afterschool tinkering program that predominantly serves African American, Latino/a and Asian-American youth (K-12) from low-income, marginalized communities.

Having Fun and Learning through Tinkering

<http://relatingresearchtopractice.org/article/387>

Petrich et al. explore three areas of design principles related to tinkering in a museum setting: activity design, environmental design, and facilitation practices. The authors detail their approach to supporting a tinkering environment and connect these principles to conceptions of learning in general and engineering practices more specifically. This paper provides a detailed illustration of design choices in the creation of tinkering programs and spaces.

Rethinking Diversity: Hybrid Language Practices in the Third Space

<http://relatingresearchtopractice.org/article/371>

Tinkering dispositions can be built in multiple kinds of settings, however, educators and students need to be able to have fluid activities where multiple ways of knowing can inform each other. Gutiérrez et al. describe how teachers can engage children’s talk and welcome diverse activities and linguistic practices to deepen learning and participation. This article explores how teachers allow students to offer local knowledge, reorganize activities, and make meaning that can connect to the official curriculum in unexpected ways. These nuanced pedagogical practices should help new educators consider how facilitation and fluid language practices could shift students’ engagement and experience with STEM-rich tinkering.

Discussion Prompts

- How do the briefs define tinkering and making? In addition to playing with familiar and complex materials, what are some other important aspects of creating rich learning environments for tinkering?
- Discuss how to support young people as they take intellectual risks, create original projects, and make creative connections to other settings like home, school, etc.
- Discuss how educators can more explicitly connect the science students experience in tinkering projects without diminishing their playful inquiries.
- How can tinkering support more equitable learning environments in STEM education? What are the challenges?

Related Resource Links

[Equity in Out-of-School STEM Learning](#)

[Grappling with Equity and Gaze: A Conversation with Shirin Vossoughi and Meg Escude](#)

[Learning STEM Through Design: Students Benefit from Expanding What Counts as “Engineering”](#)

[Making and Tinkering: A Review of the Literature](#)