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RESEARCH
BRIEF

An Overview of Learning through Making and Tinkering

Summary

Vossoughi and Bevan (2014) conducted a literature review of educational research on making and tinkering. They considered what was known about learning opportunities during high-quality tinkering and making experiences. 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.

Research Brief

Making and tinkering practices have deep historical roots in human activity where people construct, design, fix, recreate, or refine designed objects in ways that are meaningful to them and that connect to ideas from multiple and variable contexts within their lives. The authors explain that tinkering and making practices reflect "the practical, physical, and playful modes of inquiry advanced by educators such as John Dewey (1938/2007), Friedrich Froebel (1887), Maria Montessori (1912), and Seymour Papert (1980)" (p. 3). They also draw connections to the social and political work of Lev Vygotsky (1978) and Paulo Friere (1970). With these historical and philosophical roots, they review more recent research on learning through tinkering.

The review was organized into three main areas. First, making and tinkering can be designed to position young people in science learning

WHY IT MATTERS TO YOU

Creating equity-oriented learning environments means more than providing "access" or treating "sameness as fairness," particularly when there is not adequate attention paid to questions of culture, epistemology, and power. Access to tools and materials are important aspects of making, but this does not ensure that making activities will fulfill the promise of creating equitable and creative problem-solving spaces for young people. Many papers warned that making can (1) become reduced to assembling step-by-step projects (Espinoza, 2011), and (2) assume positive relationships between design processes and identity development processes without considering pedagogical skills and practices in the space.

The authors note that much of the Maker's Movement is still associates with "work, ideas, and images of middle-class white men" (p. 38) and that the current literature has not adequately engaged with existing research on equity and learning. Educators play a key role in framing processes of making and who is considered a skilled maker. They can help shape how iteration can widen definitions of intelligence , and how making is more than "a set of component knowledge and skills". Educators are integral to creating collaborative learning (rather than overly individualistic or competitive) learning environments. Finally, the authors note the need for explicit attention to issues of pedagogy and greater engagement with the socio-political question: making towards what ends?

activities that support new intellectual dispositions, identities, and future trajectories of practice. These activities and corresponding pedagogies can connect to young peoples' familiar practices from home, school, and community-based programs in order to allow for more authorship and agency in their work. Together adults and young people can make fruitful connections between projects, activities, and practices that family members engaged in at home (like cooking, electronics repair, construction projects), academic concepts, and language. These connections can lead educators to learn from student expertise; and allow young people to take on new dispositions and trajectories of participation including "working with ideas, materials, tools, and processes in increasingly complex and iterative ways" (p. 24). These activities can help young people develop new ways of viewing themselves and their interests related to a range of complementary activities across settings.

SOURCE ARTICLE

Vossoughi, S. & Bevan, B. (October, 2014). Making and Tinkering: A Review of the Literature. National Research Council Committee on Out of School Time STEM: 1-55.
http://sites.nationalacademies.org/cs/groups/dbassesite/documents/webpage/dbasse_089888.pdf

Second, making and tinkering programs can be structured and implemented in ways that support young people's learning and development by contextualizing STEM concepts in meaningful activities that connect to multiple disciplinary practices (art, science, literacy, math, engineering, etc.). Making programs across studies treated the development of scientific concepts and skills "as tools to achieve desired ends, rather than ends in and of themselves" (p. 21). Ideally, these scientific concepts and skills are meaningfully related to art, design, and computer sciences (Kafai & Peppler, 2010). Studies also found that young people developed new roles within their existing making communities and/or in other school and home communities as they learned to work with new materials in increasingly complex and iterative ways.

Finally the report suggested that orchestrating programs to help young people build interest, skills, and shared goals can be achieved by encouraging collaboration, sharing amongst young people, and fluid roles between more expert and novice group members. Researchers found that creating flexible pedagogical environments that support a range of group projects or solo projects, community or social action projects allows for generous and intellectually generative learning environments. These supportive environments forefront pedagogy that allows for "just-in-time access to STEM and arts based skills" (Hetland, et al, 2013), attends to where ideas come from and how ideas are privileged within the space.

Theoretical Basis

There are multiple theoretical underpinnings across the literature reviewed in this report. Constructivist and constructionist theories of learning allow researchers to explore how the process of discovery and the physical construction of objects can lead to conceptual development. Constructionism is a process of learning that supports student-driven problem-solving with materials and guided support from educators. Sociocultural and social practice theories of learning foreground the role of the social environment and the cultural and historical practices and values that shape the process of learning. Still other theories—such as critical race theory, critical pedagogy, and socio historical theories—address the importance of student agency, activism, and transformative aspects of creating equity-oriented learning environments through tinkering and making practices.

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