

STEAM Creative & Innovative Thinking Cohort



Summary of Findings

Create a Duck Out of LEGO in 60 Seconds



STEAM (Mejias et al., 2021)

Creativity and Innovation (Clapp et al., 2017; Peppler, 2017)

- ⌞ Creativity and Innovation are not individual activities – they are a shared collective activity
- ⌞ Play: suspension of disbelief – moment of disbelief around play; how simple it can be to innovate, to collaborate, to step outside our box; breaking down the silos (Wohlwend & Peppler, 2015)
- ⌞ Iteration: *If I did it again, what would I change?* (Resnick & Rosenbaum, 2013; Wilkinson & Petrich, 2014)
- ⌞ Constraints are important to creative outcomes: everyone had the same six bricks, no two people assembled the same duck. The collection is more interesting than the individual parts
- ⌞ Makerspaces and other spaces as exemplary designs for supporting Creative & Innovative Thinking in STEAM in equitable ways

Structure (Bevan et al., 2018; Bevan et al., 2014)

- ⌞ Method of seeing/observation rooted in early childhood / lifelong learning approaches (Cohen et al., 1997)
- ⌞ Facilitation/framing: *Look at all of the ducks (and how unique they all are)* as opposed to voting up the best duck
- ⌞ Using materials that don't require extensive instructions
- ⌞ Incorporating a debrief discussion to make sense of the possible implications for our teaching and learning

Equity (Vossoughi et al., 2016)

- ⌞ Found, everyday materials as an important starting point for creativity in STEAM but also an equitable one (Hawkins, 1965a/b)
- ⌞ Chose LEGOs for a reason (hypothesized easy engagement but some challenges with access)
- ⌞ No one right way to put these bricks together as opposed to the one right way
- ⌞ Work like Guerilla Science offers insights into how we broaden participation through the design of STEAM activities (Rosin et al., 2021)

Priorities for Future Research

Equity in STEAM Education

- ⌞ The intersection of creativity, innovation, and equity in STEAM literature is somewhat siloed, with limited integration.
- ⌞ All aspects of STEAM learning need to be considered through the lens of equity. Universal design studies can inform the field on how equity can be better integrated from the start.
- ⌞ There is a need for more research on playful learning across cultures.

Creativity and Early Childhood

- ⌞ More data-driven studies are needed to explore young children's creativity. Early childhood begins as early as 2–3 years old, yet there is not enough literature or data on young children and creativity.

Professional Development and Collective Creativity

- ⌞ Professional development should address access and ability to enact creativity and innovation within educators' communities.
- ⌞ Mindsets must consider the context of the educator as well as the individual learner.
- ⌞ Collective creativity is essential for educators and designers to create environments fostering creativity.
- ⌞ Learning from and documenting collective creativity in STEAM settings is needed.

Assessment and Framing of Creativity

- ⌞ There is a lack of comprehensive assessment of creativity, innovation, and equity in STEAM. Additionally, the advantages of integrating art and science for creativity, innovation, and equity need better framing and marketing.
- ⌞ The role and goals of collaboration in STEAM education require further exploration.

Engagement and Perception of Creativity

- ⌞ STEAM education should focus on increasing engagement and self-identity in STEAM disciplines compared to STEM. Creative learning experiences are not always taken seriously, particularly for students who may not excel academically but show deep engagement and thoughtfulness in creative endeavors.

Case Study 1: STEAM for All

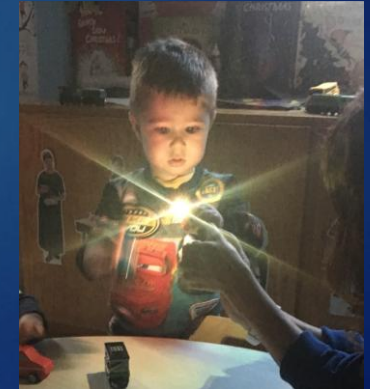
Michele Browning, STEAM Preschool

Project

STEAM is both an effective pedagogy and a powerful way to nurture foundational traits like perseverance, collaboration, and optimism in learners of all ages. By using art as a gateway to other subjects, lessons are designed within students' zones of proximal development, encouraging exploration through play, conversation, and storytelling to foster critical thinking and creativity.

Key Outcome 1: Enhanced Creative Problem-Solving Skills
STEAM engages children in hands-on learning that builds their ability to approach challenges from diverse perspectives. Activities like block engineering, art inspired by science, and coding help even the youngest learners unpack complex ideas like Bernoulli's Principle, using everyday items to nurture curiosity and problem-solving.

Key Outcome 2: Innovative Interdisciplinary Thinking
STEAM connects disciplines, showing children how fields like math and art intersect to solve real-world problems. Projects like creating tessellations or exploring circuits through holiday lights foster a holistic perspective, with activities ranging from chemistry experiments to sensory play with kitchen ingredients.



Case Study 2: Embodied Physics

Project:

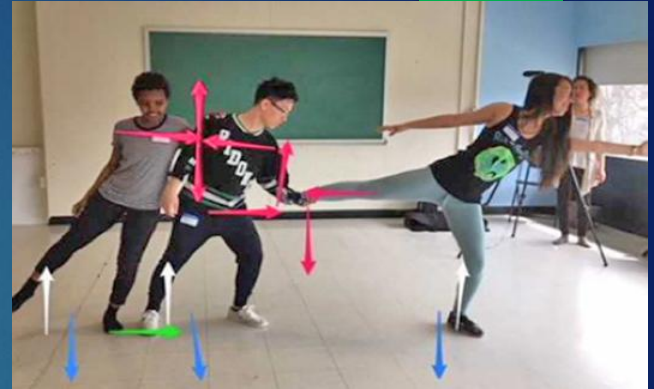
Embodied Physics Learning Lab (EPLL) engages teens in physics learning through kinesthetic experiences, embodied explorations, and dance-making activities. This 8-session program provides opportunities for youth to engage in new ways to see and understand physics and dance.

Key Outcome 1:

This work demonstrated robust impact for youth physics learning and identity development, providing expanded access for sense-making and opportunities for culturally sustaining teaching and learning. Specifically, dance offered an embodied lens for physics investigation, providing opportunities for girls to draw on their own bodily experience to make valuable connections and insights, positioning them as experts of their own physics experience.

Key Outcome 2:

Our findings show that embodied exploration of physics through dance supported sustained engagement, invited youth to engage in inquiry using multiple movement vocabularies, and offered participants opportunities to connect personally and culturally to physics concepts and ideas.



Case Study 3: Code to Cardboard Summer Camp

Ryan Jenkins, Wonderful Idea Co.

Project:

A week-long program where 7-12 year olds get introduced to digital tools like block-based coding and microcontrollers and then use those computational elements to construct their own projects based on individual ideas and questions within a shared theme.

Key Outcome 1: Scrappy Materials Over Kits

From an equity perspective, when digital (or analog) tinkering projects are made with things like scrap wood and cardboard, learners can quickly and easily add parts, remove elements and customize their creations. Using low cost, recognizable and friendly materials allows learners to start out with something approachable and complexify ideas at their own pace.

Key Outcome 2: Creative Collaborative Challenges

The concept of wide walls steered us away from traditional design challenges or engineering focused prompts like creating the fastest car or designing a battle ready robot. These competitive projects constrain the possibilities for expression. We prefer more creative and collaborative coding projects like creating a computational zoo or a light-up underwater world which offer many pathways through the activity and ways for learners to explore art and design.



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