

CONVERTING STEM TO STEAM

The Case for Science, Technology, Engineering, Arts, and Mathematics

“The game is changing. It isn’t just about math and science anymore. It’s about creativity, imagination, and, above all, innovation.” **Business Week Magazine**

OR, MAYBE IT HAS ALWAYS BEEN THIS WAY, AND WE ARE SIMPLY REALIZING IT ANEW...

“Art is the queen of all sciences communicating knowledge to all the generations of the world.” **Leonardo Da Vinci**

The initiative to turn “STEM to STEAM” adds art (“A”) to our national effort to encourage careers in science, technology, engineering, and mathematics (STEM). By better integrating art education we may strengthen students’ minds for design and innovation, and support wide-reaching learning and achievement. A growing body of research supports turning STEM to STEAM:

- The American economy thrives on creative innovation in STEM fields,
- Studies increasingly demonstrate how art education may benefit students more broadly, and
- It appears that our great scientists are more likely to practice or appreciate art.



STEAM and the Economy



There is striking evidence of the demand for more creativity and innovation in the American economy. In a recent survey, over four hundred employers reported they significantly value creativity and innovation and expect its importance to increase over time. Yet a majority of these employers found high school graduates to be “deficient” in creativity and innovation, and fewer than a quarter of employers considered college students to be “excellent” in creativity and innovation. Another report found that while educators and employers agree that creativity is increasingly important, fully eighty-five percent of employers seeking creative hires cannot find the applicants they seek.

“In addition to giving our children the science and math skills they need to compete in the new global context, we should also encourage the ability to think creatively that comes from a meaningful arts education.”

–President Obama

Arts and the Brain

Both art and science are driven by observation, experimentation, discovery, collaboration, and innovation, and research suggests that art education may broadly benefit learning. For example, studies show that children randomly assigned to receive regular music instruction also improved related skills such as fine motor control; furthermore, brain structures changed for those receiving music instruction compared to those who did not.



“The similarities between how artists and scientists work far outweigh their stereotypical differences.”

–John Maeda

President of the Rhode Island School of Design, which spearheaded the initiative to turn “STEM to STEAM”



Other research shows language development is closely correlated with music training. One study gave children writing prompts and asked one group to draw before responding, and another group simply to respond; the group that drew provided more organized and detailed responses.

Additionally, attention skills and general intelligence have been shown to improve for children who practice an art.

Considering low-income students in particular, those who participate in arts education compared to those who do not are:

- Four times as likely to demonstrate high academic achievement,
- Three times as likely to have high attendance, and
- More likely to participate in a math or science fair or to be elected to class office.

By their mid-twenties, low-income students with arts education are more likely to have succeeded in college, built careers, and become active members of their communities by volunteering or voting. Additional research shows that for low-income high school students, arts-rich experiences are associated with higher high school GPAs and rates of graduation; greater college aspirations; and more four-year college enrollment and graduation.



STEAM Education

Training in the arts can cultivate skills that are invaluable in STEM fields as well:

- Creativity to “think outside the box” and approach projects from diverse perspectives,
- Confidence to step outside one’s comfort zone and learn from one’s mistakes and move on, and
- Perseverance to master an art such as music which involves practicing a complex skill until it becomes something simple you can build upon.

What might STEAM-specific education look like? While we have only scratched the surface, exciting innovations are underway. Picture a third grade math class in which students used coat hangers and buttons to construct Calder mobiles: they learned the idea behind linear equations, by discovering that one set of buttons could be balanced by an equivalent yet distinct set on the other side. Or imagine a fifth grade science class coupled with a dance class that served to illustrate the new vocabulary: “Use your momentum to get yourself into turn,” “What slows our arms down? Inertia!” and “Now focus on lowering your center of gravity.”



Looking Forward

It is a key moment to understand and respond to evidence identifying the value of the arts alongside STEM education. While STEM funding flourishes, education budgets nationwide are placing arts programs among the first to go. This redistribution towards STEM, away from the arts, may actually harm aspects of the STEM economy by losing sight of the importance of creativity and innovation in the success of the STEM economy.

But momentum is building to turn “STEM TO STEAM,” including a new bipartisan STEAM caucus in Congress. Today’s economy requires creativity, imagination, and above all innovation. Both research and experience suggest that art, design, and innovation may indeed lead the way for science, technology, engineering, and math, generating and communicating new knowledge for today’s world.



DOWNLOAD A COPY OF THIS DOCUMENT AT: ccspecialpopulations.org OR jspac.org

This brochure is based on a research paper with full citations by Elizabeth Dayton, PhD, available at sierraschoolworks.com, and funded by Sierra College CTE Community Collaborative “Sierra STEM” grant #12-140-271 and the California Community College Chancellor’s Office, Economic & Workforce Development Division. Funding for this publication was provided by the Special Populations Collaborative Project with funding from the Carl D. Perkins Career and Technical Education Act of 2006 grant #14-165-001 awarded by the California Community Colleges Chancellor’s Office to West Hills Community College District.