

STEAM Education in K-12 Schools: A Review of Evidence Required

A report of qualifying research from The Institute for Arts Integration and STEAM

This report is being provided to share the Institute for Arts Integration and STEAM's (IAS) approach to STEAM (Science, Technology, Engineering, the Arts, and Mathematics) education and offer educators the supporting evidence for selecting this approach.

It is important to understand there are a variety of definitions for the term STEAM, and we make no claim that one is better than another. Based on our review of the existing pertinent research, our definition is derived from studies qualifying as Tiers 1-3 of evidence for integrating the arts across STEM content areas.

The IAS Definition of STEAM

Our organization defines [STEAM](#) this way:

“STEAM is an educational approach to learning that uses Science, Technology, Engineering, the Arts and Mathematics as access points for guiding student inquiry, dialogue, and critical thinking. The end results are students who take thoughtful risks, engage in experiential learning, persist in problem-solving, embrace collaboration, and work through the creative process.”

This definition is supported by both qualitative and quantitative research, which includes the following studies:

[Five years of integrating science and dance: a qualitative inquiry of constructivist elementary school teachers.](#) Valls, Black, & Miyoung, 2019.

[Using Arts Integration to Make Science Learning Memorable in the Upper Elementary Grades: A Quasi-Experimental Study.](#) Graham, & Brouillette, 2016.

[A study on the relationship between theater arts and student literacy and mathematics achievement.](#) Inoa, Weltsek, & Tabone, 2014.

Our definition and approach to STEAM is one of integrating the arts across and through the STEM areas. Given the large breadth of research supporting arts integration, as well as the research supporting integrated methods for implementing STEM, our definition aligns with peer-reviewed, statistically significant evidence of an arts-integrated approach to STEAM education.

Federal Funding for STEAM and Arts Integration in the Every Student Succeeds Act (ESSA)

With the passage of the Every Student Succeeds Act of 2015, P. L. 114-95, § 129 Stat. 1802 (2015), federal funds are now available to support the implementation of both arts integration and STEAM in schools through at least 12 sources within the law (Ludwig, Boyle, & Lindsay, 2017).

In the ESSA law, the arts and music are included in a definition of a “well-rounded education,” which has replaced the current term “core academic subjects.” This term, “well-rounded education,” including the arts and music, is clear throughout the bill, and ensures that federal funds are used to support educational opportunities through a variety of subjects.

Those subjects include English, language arts, writing, science, technology, engineering, mathematics, foreign languages, civics and government, economics, arts, history, geography, computer science, music, career and technical education, health, physical education, and any other subject determined by state or local governments.

Having the arts included in the definition of a “well-rounded education” creates eligibility for funding under ESSA, including Title I, II and IV funds and grants.

The bill also includes support to schools that provide a well-rounded education through programs that integrate academic subject areas, including the arts, into STEM. This solidifies the place of STEAM in our schools.

Qualifying Evidence to Support STEAM through ESSA Funding

In order to use the federal funds from ESSA, schools must show they are using quantitative research-based approaches that contain evidence of positive outcomes. Based on the ESSA law, acceptable evidence falls into one of 3 tiers: Strong, Moderate or Promising.

Tier 1 – Strong Evidence: supported by one or more well-designed and well-implemented randomized control experimental studies.

Tier 2 – Moderate Evidence: supported by one or more well-designed and well-implemented quasi-experimental studies.

Tier 3 – Promising Evidence: supported by one or more well-designed and well-implemented correlational studies (with statistical controls for selection bias).

What to Look For When Reviewing Research

When reviewing research surrounding arts integration and STEAM, it is important to determine if the research has been peer reviewed to ensure the academic integrity of the study is maintained. Additionally, monitor the source of the research. Ensure that the study you are reviewing was originally published by an outside source and not simply uploaded to a crowdsourced research site by the individual researcher. Finally, look for signs of a high-quality, accepted research design. These include *quantitative* research designs (i.e. descriptive, correlational, quasi-experimental, or experimental), and *qualitative* designs (i.e. phenomenology, ethnography, grounded theory, case study, or narrative).

Connecting the Dots: A Table of Research and Evidence Levels

In the table below, you'll find a list of research supporting our approach to STEAM education, as well as it's qualifying level of evidence and which fund source would correlate:

Link to Research	Level of Evidence	Referenced Title Fund Source
Using Arts Integration to Make Science Learning Memorable in the Upper Elementary Grades: A Quasi-Experimental Study.	Tier 2	Title I, Sec. 1003: School Improvement
A study on the relationship between theater arts and student literacy and mathematics achievement.	Tier 1	Title I, Sec. 1003: School Improvement
Five years of integrating science and dance: a qualitative inquiry of constructivist elementary school teachers.	Tier 3	Title I, Sec. 1003: School Improvement
Cultivating Common Ground: Integrating Standards-Based Visual Arts, Math and Literacy in High-Poverty Urban Classrooms	Tier 1	Title II, Part A: Supporting Effective Instruction

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All of our courses, conferences, and curricular supports are fully supported by high-quality research, and include the requisite Tiers 1-3 levels of evidence. **This ensures whatever path you take with us, you can leverage Federal Funds to help support your goals.**

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Additional Research and Policy Position Papers

In addition to the research featured in the table above, here are a list of other selected articles which may prove helpful in exploring the STEAM education approach advocated by IAS:

General Research:

- [Secondary school creativity, teacher practice and STEAM education: An international study](#)
- [Co-Measure: developing an assessment for student collaboration in STEAM activities](#)
- [Designing STEAM for Broad Participation in Science](#)

From *The Education Commission of the States*:

- [Opportunities for STEAM Education Through ESSA and Perkins V](#)
- [Preparing Students for Learning, Work and Life Through STEAM Education](#)
- [Policy Considerations for STEAM Education](#)

From *Arts Education Policy Review*:

- Molly L. Kelton, Patti Saraniero. (2018) [STEAM-y Partnerships: A Case of Interdisciplinary Professional Development and Collaboration](#). *Journal of Museum Education* 43:1, pages 55-65.

- Jen Katz-Buonincontro (2018) Gathering STE(A)M: Policy, curricular, and programmatic developments in arts-based science, technology, engineering, and mathematics education Introduction to the special issue of *Arts Education Policy Review: STEAM Focus*, Arts Education Policy Review, 119:2, 73-76, DOI: [10.1080/10632913.2017.1407979](https://doi.org/10.1080/10632913.2017.1407979)

From *State Education Agency Directors of Arts Education (SEADAE)*:

- [SEADAE Definition of STEAM Education](#)

Conclusion

STEAM education is an approach which many schools are excited to use with their students. To facilitate that process, having access to a clear definition supported by qualifying evidence that meets ESSA requirements is imperative. Through this report, IAS hopes to provide schools with the research they need to take their next steps in integrated learning.

STEAM- Related Research

Rosen-O’Leary, R., & Thompson, E. (2019). STEM to STEAM: Effect of visual art integration on long-term retention of science content. *Journal for Leadership and Instruction*, 18(1), 32-35.

Brouillette, L., & Graham, N. (2016). Using arts integration to make science learning memorable in the upper elementary grades: A quasi-experimental study. *Journal for Learning through the Arts*, 12(1), 1-17.

Quigley, C., & Herro, D. (2016). “Finding joy in the unknown”: Implementation of STEAM teaching practices in middle school science and math classrooms. *Journal of Science Education and Technology*, 25(3), 410-426.

Ghanbari, S. (2015). Learning across disciplines: A collective case study of two university programs that integrate the arts with STEM. *International Journal of Education & the Arts*, 16(7), 1-21.

Taylor, H., & Hutton, A. (2013). Think3d!: Training spatial thinking fundamental to STEM education. *Cognition and Instruction*, 31(4), 434-455.

Arts Integration Research Connected to STEM Disciplines

Song, M., Ludwig M., and Marklein M.B., (2016). “Arts Integration: A Promising Approach to Improving Early Learning,” American Institutes for Research.

Cunnington, M., Kantrowitz, A., Harnett, S., & Hill-Ries, A. (2014). Cultivating common ground: Integrating standards-based visual arts, math, and literacy in high poverty urban classrooms. *Journal for Learning through the Arts*, 10(1), 1-24.

Hardiman, M., Rinne, L., & Yarmolinskaya, J. (2014). The effects of arts integration on long-term retention of academic content. *Mind, Brain, and Education*, 8(3), 144-148.

An, S., Capraro, M. M., & Tillman, D. (2013). Elementary teachers integrate music activities into regular mathematics lessons: Effects on students' mathematical abilities. *Journal for Learning through the Arts*, 9(1), 1-19.

Kinney, D. W., & Forsythe, J. L. (2005). The effects of the Arts IMPACT curriculum upon student performance on the Ohio fourth-grade proficiency test. *Bulletin of the Council for Research in Music Education*, 164(Spring), 35-48.

Werner, L. (2001). *Changing student attitudes toward math: Using dance to teach math*. Minneapolis, MN: University of Minnesota, Center for Applied Research and Educational Improvement.