Imagination's Role in STEM Practice and STEM Education: Categories and definitions

Across literature on STEM practice and STEM education, imagination is positioned in a range of ways. Most commonly, we found imagination positioned as a **process**, through which certain STEM outcomes might be achieved. Imagination wa sometimes framed as a **trait or capability**, or it was positioned within an argument for its **value** in STEM. Less frequently, imagination was positioned as an **outcome** of STEM endeavors, or positioned within a **theoretical framework**. Often, these different roles overlapped within the literature.

Trait or Capability: Personality trait, capacity, aspect of human development, or otherwise a characteristic of humans that varies over time, and from person-to-person.

Process: A practice, a way of engaging, or step within a larger progression that, if engaged in properly, can support or lead to some other ultimate end-goal.

Theoretical Framework: A concept of how imagination influences ways of engaging in the world.

Outcome: A skill, ability, or practice that can be fostered and improved; the end goal of some intervention or experience.

Valuable: Arguing for imagination's value, as either important in its own right (intrinsic value), or towards some other goal (instrumental value).

Imagination's Role in STEM Practice and STEM Education: Exemplary sources from the literature

The following table includes just a sample of the literature reviewed. Each resource positions imagination differently, helping to illustrate the range of ways imagination plays a role in relation to STEM education and STEM practice. While overlap exists, these resources were highlighted because they paint a clear picture of the role imagination plays within the work, closely aligning with the categories emergent from this review.

Each citation includes a link to the full-text (if available online) and/or a link to the stable online source.

Process: A practice, a way of engaging, or step within a larger progression that, if engaged in properly, can support or lead to some other goal.

Achiam, M. (2016). The role of the imagination in museum visits. Nordisk Museologi, 2016, 89–100. DOI

Fleer, M. (2019). Scientific Playworlds: A Model of Teaching Science in Play-Based Settings. Research in Science Education, 49(5), 1257–1278. DOI

Sanders et al. (2008). Learning basic surgical skills with mental imagery: Using the simulation centre in the mind. Medical Education, 42(6), 607–612. DOI

Evans et al. (2019). Using Creativity and Imagination to Understand our Algorithmic World: A Conversation with Dr. Ed Finn. TechTrends, 63(4), 362–368. DOI

Trait or Capability: Personality trait, capacity, aspect of human development, or characteristic that varies over time, or from person-to-person.

Fesmire, S. (2010). Ecological Imagination. Environmental Ethics, 32, 183–203. DOI

Mun et al. (2015). Exploration of Korean Students' Scientific Imagination Using the Scientific Imagination Inventory. Int. J. of Sci. Ed., 37(13), 2091–2112. DOI

Yueh et al. (2013). Are there differences between science and engineering majors regarding the imagination-mediated model? Think. Skills & Creat., 10, 79–90. DOI

Valuable: Arguing for imagination's value, as either important in its own right (intrinsic value), or towards some other goal (instrumental value).

Coeckelbergh, M. (2006). Regulation or responsibility? Autonomy, moral imagination, and engineering. Sci., Tech, & Human Values, 31(3), 237-260. DOI

Diamond, S. (2019). Addressing the imagination gap through STEAMM+D and indigenous knowledge. *Proc. of the Nat'l Acad. of Sci.*, *116*(6), 1851–1856. DOI

Jensen, S. (2016). Empathy and Imagination in Education for Sustainability. Canadian Journal of Environmental Education, 21, 89–105.

Outcome: A skill, ability, or practice that can be fostered and improved; the end goal of some intervention or experience.

Cheng, M.-M., & Chuang, H.-H. (2018). Learning Processes for Digital Storytelling Scientific Imagination. EURASIA Journal of Math., Sci. and Tech. Ed., 15(2). DOI

Siew, N. M. (2017). Fostering Students' Scientific Imagination In Stem Through An Engineering Design Process. Prob. of Ed. in the 21st Century, 75(4), 375–393.

Levrini et al. (2019). Developing future-scaffolding skills through science education. International Journal of Science Education, 41(18), 2647–2674. DOI

Theoretical Framework: A concept of how imagination influences ways of engaging in the world.

Buenrostro, P. M., & Radinsky, J. (2019). Looking at My (Real) World through Mathematics: Memories and Imaginaries of Math and Science Learning. Cognition and Instruction, 37(3), 390–407. DOI

Shaw, M. S. (2020). Restorying through Computational Quilts: A Critical Approach Towards Reimagining Computer Science. Proceedings of the 2020 ACM Conference on International Computing Education Research, 344–345. DOI

Yusoff, K., & Gabrys, J. (2011). Climate change and the imagination. Wiley Interdisciplinary Reviews: Climate Change, 2(4), 516–534. DOI