Imagination in STEM Education and Practice: Comprehensive Literature Review (Executive Summary)

The Museum of Science, Boston conducted a literature review using methods described in Onwuegbuzie & Frels (2016) *Seven Steps to a Comprehensive Literature Review.* The work accomplished across the **seven steps** is summarized below. The **research questions** were: (a) What types of literature address imagination in STEM (science, technology, engineering, and math) education and practice? (b) How does the literature define imagination? (c) How does the literature position the role of imagination in STEM?

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1. Exploring Beliefs & Topics

Team members reflected on beliefs about imagination and its role in STEM, and unpacked preconceptions about the topic, helping us frame guiding questions and consider our biases.

3. Storing Information

Our team used Zotero to store and organize articles and Excel to document and track our review and analysis activities.

2. Initiating the Search

Searched Databases and Journals: ERIC, EBSCOhost, Gale Academic OneFile Select, Google Scholar, CAISE, Visitor Studies, Journal of Museum Education, Museums and Social Issues, Museum International

Search Syntax:

(imagination OR imagine OR imagining OR imagines OR imaginative) AND ("science museum" OR "science center" OR "science centre" OR "informal science education" OR "informal science learning" OR "informal STEM" OR museum OR science OR technology OR engineering OR math OR STEM OR STEAM)

4. Selecting & Deselecting Information

Criteria for selection:

- Had a clear focus on imagination and STEM
- Imagination was clearly defined
- Addressed at least one guiding question

Criteria for deselection:

- No connection between imagination and STEM
- Imagination was only referenced casually
- No English translation was accessible

5. Expanding the Search

We expanded our pool of potential pieces of literature to review through:

- **Expert input** (e.g., project advisors)
- **Document reviews** (e.g., project descriptions from informalscience.org)
- **Observations** of participant conversations at the convening

3,320 titles and abstracts reviewed for relevance → **597** full-texts reviewed against selection criteria → **137** pieces of literature selected for analysis

6. Analyzing & Synthesizing Information | 7. Reporting

We conducted a content analysis to describe the sample and cross-cutting characteristics of the works, and a thematic analysis to categorize how imagination was positioned.

What types of literature address imagination in STEM?

Publication Details:

- Publication dates ranged from **1960 to 2021**
  - **69%** were published in the prior decade (2012-2021)
- **44%** were published in the US

Types of Work:

- **44%** were non-empirical
- **42%** were empirical research
- **14%** were books

How does the literature define imagination?

Defining what imagination is:

- Imagination is defined as a(n): ability, activity, capacity, faculty, foresight, and/or process.

Contexts where imagination emerges:

- Within the self or with others, in relation to what is absent, in fictive or hypothetical situations, in relation to past or future.

Imaginative ways of thinking:

- Many"-ing" words relate what it looks like when imagination is happening.

How does the literature position the role of imagination in STEM?

Sector Addressed

- **64%** addressed STEM education
  - 40% addressed formal education
  - 16% addressed informal education
  - 9% addressed multiple contexts
- **52%** addressed STEM practice
- **12%** addressed the arts

Audience positioned as "imagining"

- **50%** framed students as "imagining"
- **42%** framed professionals as "imagining"
- **18%** framed the public as "imagining"
- **22%** did not name an explicit audience

Imagination's Role in STEM

Works positioned imagination within STEM in a range of ways:

- **64%:** imagination as process
- **29%:** imagination as trait
- **29%:** imagination as "valuable"
- **21%:** imagination as theoretical
- **20%:** imagination as outcome
- **7%:** described multiple roles

Conclusion

Literature on imagination's role in STEM has become more abundant in recent years, presenting a complex picture of the many ways imagination is defined and positioned in STEM education and practice.

Imagination was less often addressed in informal STEM education, suggesting a need for more intentional focus in this sector. Trends in the current landscape, presented in this review, could inform future research to fill this gap.

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