CROSSING THE BOUNDARIES: MAPPING THE GAPS BETWEEN EXPERT AND PUBLIC UNDERSTANDINGS OF BRIDGING STEM LEARNING ENVIRONMENTS BY KEVIN LEVAY, ANDREW VOLMERT, AND NAT KENDALL-TAYLOR OF THE FRAMEWORKS INSTITUTE.

Children learn STEM in both formal and informal environments, with the most effective learning resulting from experiences that involve connections across various environments and collaborations among formal and informal institutions.

This report from the FrameWorks Institute, prepared by Drs. Kevin Levay, Andrew Volmert, and Nat Kendall-Taylor, is focused on developing communication practices by STEM professionals and educators to gain public understanding and support for expanded STEM teaching.

They do this by outlining results of interviews with two distinct groups, experts in STEM on the one hand, and the general public on the other (see the appendix to the report for information about the interviews and research methods they used). When that ground is clear, they analyze the gaps between the two groups—what they describe as the "untranslated expert story of bridging STEM learning"—and some implications for how to improve communication about the value of STEM in society. All of this is intended to help in the creation better STEM education for children.

The authors begin by describing understandings among professionals about STEM, addressing four key questions:

- What is STEM learning and why does it matter?
  —problem-solving, critical thinking skills, hands-on learning, benefits individuals and society
- Where do children learn STEM?
  —both formal and informal environments, informal environments (especially home) are vital, organic opportunities for STEM learning are affected by racial, socioeconomic, gender and geographic variables
- Why is it important to bridge children's STEM learning across different environments?
  Different environments provide distinct resources and opportunities, most effective STEM learning results from connections across various environments which can demonstrate its relevance and wide applicability in living and also reduce social disparities in learning
- How can we better bridge children's STEM learning across different environments?
  Strengthen collaboration across formal and informal institutions, engage and support parents in children's STEM learning, develop new and enhanced programming and resources for informal environments. ensure access to technology for all, build more flexibility in evaluations of schools and students, increase funding for research especially for connecting STEM across environments

The authors then review dominant cultural models and thinking that shape public thinking about STEM. They stress that people have multiple ways to think about STEM and these often shift depending on context and social cues. They also indicate that the research reveals "cognitive holes," areas that need filling in for a fuller understanding of STEM.

They identify nine cultural models:

- Children as Sponges/Container (children are empty space needing to be filled up)
- Instructional (adults guide or control learning)
- Interactivity (depending on cues, the public can see active and dynamic interaction between children and adults)
- Rechargeable Attention Battery (learning is a school-centered process that drains children's energy and they require "down time" outside school)

- Back to Basics (only thing children need is "the basics"—reading, writing, and arithmetic— and any other learning has to come after those three are attended to)
- Highly Trained Expert (students need an adult with formal teacher training and/or subject area mastery)
- Quality=Caring (children learn from parents and schools and these teachers must be focused on caring for them)
- STEM is specialized (STEM seen as highly advanced and specialized knowledge that needs to be offered only after the basics are met and only to students who have displayed aptitude for and interest in the subject areas)
- STEM as Creative Necessity (STEM skills and knowledge are important in performing everyday activities and tasks, helping children and adults navigate life)

Each of these models has implications for communication about STEM with the public. For example, the first two areas make it less likely that children and their parents will see the need to connect various STEM learning situations. On the other hand, the Interactivity model may help increase support for STEM in informal environments. What the authors suggest is that those working to increase public engagement with STEM think carefully about what communications styles and content will be most helpful in either overcoming a problematic model or using some aspect of the model to create shifts in social understanding and acceptance of STEM.

They also describe a series of cultural models of technology and learning.

- Technology as Artificial Distraction (technology prevents children from engaging with situations and people in the "real" world)
- Engaging Technology (less common perspective thinks of interaction and responsive as key elements of learning, often connected with digital games and applications)

Each of these has implications for communications strategies. Given the need for far more communication with parents and the public about STEM, there is a need for proponents not to unintentionally activate the Technology as Distraction model by referencing the negative ideas even when critical of them.

The authors next turn to cultural models of learning environments.

- People Not Places (largely focused on people rather environments)
- Home and School (focus on these two and only these two locations for learning)
- Libraries as Book Storage (most see libraries as depositories for physical resources, books and periodicals, outdated due to technological advances)
- Museums Are Flexible (interactive, diverse and flexible in purpose and function)
- Extra Dose (non-school environments are useful for providing something extra to be added to what students are being taught in school)
- Filling in the Gaps (students need to learn about different things in different places)
- Breaking Up the Routine (different environments can combat boredom and increase engagement)
- Home/School Divide (home learning focuses on values, school on academics)
- Home-School Ladder (child's learning begins at home and completed at school)

Each of these also has implications for communications strategies. For example, the People Not Places and Home and School models ignore many places where children learn and minimize many aspects in and connections between learning environments. On the other hand, the Filling in the Gaps model can help parents recognize that children can learn different things and in different ways in different places.

The report summarizes areas of overlap between expert and public understandings of STEM learning. This common ground offers opportunities for communicators to build on in their strategies. For example, focus on problem-solving skills and hands-on activities can create interest in STEM.

In addition to overlaps there are significant gaps between the two groups related to what STEM is, what it can do for students and how it can help society. For example, while experts believe that STEM learning happens

all the time with anyone, the public perceives this happens later on with teachers in school. Further, parents are seen by experts as essential partners in STEM education and the public perception is of parents as limited in their ability to participate. This view is sustained by the public view that schools must take the lead in STEM education. They authors identify several more of these gaps.

In conclusion, they suggest some key reframing tasks that will help develop new strategies to shift the conversation about STEM to more holistic community-wide possibilities and practices. These tasks include redefining and explaining what connections among STEM learning environments should look like, concretizing the public's understanding of what makes ideal environments for STEM learning, broaden understanding of how technology can facilitate STEM learning, and increase awareness of how the multiple partnerships within and across different environments can assist in students' STEM learning.

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https://joanganzcooneycenter.org/wp-content/uploads/2018/05/jgcc_frameworksinstitute_crossingtheboundaries.pdf

Thanks to generous support from the Carnegie Corporation of New York, *Our Neighborhood,* is a compilation of stories and research from the family engagement field. It is intended to be a living repository and guide for STEM Learning Ecosystems and other communities interested in cultivating strong community partnerships to prepare the next generation.

This annotated bibliography was compiled by TIES for *Our Neighborhood.*