Crossing the Boundaries

Mapping the Gaps between Expert and Public Understandings of Bridging STEM Learning Environments

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A FrameWorks Map the Gaps Report

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Introduction

This report presents findings from interviews conducted with experts and members of the American public about STEM learning environments. Interviews with members of the public were analyzed for the shared assumptions that shape how people think about and understand STEM learning environments and their relationship to one another. By comparing these public understandings to those of experts on STEM learning, we identify areas that communicators must target to increase understanding of, and boost support for, the policies and programs needed to better connect and bridge STEM learning environments.

To more effectively connect children's STEM learning environments and improve learning, advocates need strategies to change how people think about and understand STEM learning. They need to shift expectations about how and where children learn, and expand public thinking about the value of building connections between children's learning environments and the power and role of technology in providing and strengthening these connections.

Understanding this, a group of foundations (the Oath Foundation, the Heising-Simons Foundation, and the Bezos Family Foundation) is sponsoring the Families Learning Across Boundaries (FamLAB) project led by the Joan Ganz Cooney Center and in partnership with New York University, Stanford University, and the FrameWorks Institute. The aim of this project is to mobilize a community of caregivers, educators, technology developers, and investors dedicated to solving the bridging problem, with a focus on the roles that interactive and communications technologies can play in both strengthening different learning environments and propelling children's learning across these environments. This report represents the first stage of Strategic Frame Analysis®—a multi-method investigation that combines theory and methods from various social science disciplines; the goal is to arrive at reliable, research-based recommendations for how to better communicate about bridging STEM learning environments. This report establishes the core ideas that STEM experts wish to communicate about bridging these environments and identifies the features of public understanding that facilitate or challenge the communication of these ideas.

The report unfolds in three parts:

1. ***Expert Perspective Analysis:*** a distillation of the concepts about bridging STEM learning environments that experts wish to communicate—the "big ideas" that the field wants to get across in its communications with the public and other non-expert audiences.

2. ***Public Perspective Analysis:*** a summary of the cultural models,[1] or widely shared patterns in public thinking about STEM learning and learning environments. These cultural models shape public opinion and provide insight into whether and why certain frames build, or undermine, support for reforms intended to more effectively bridge STEM learning environments.

3. ***Framing Implications:*** a discussion of the implications of the findings of this work for communications practice.

A description of the methods used is available in the Appendix.

The Expert Perspective on Bridging STEM Learning Environments

This section presents a distillation of the themes that emerged from an analysis of 10 interviews with research and practice experts on the bridging of STEM learning environments. Taken together, these themes constitute what we call the "untranslated expert story of bridging STEM learning." These are the core set of understandings that those working to build stronger bridges across STEM learning environments want to communicate to external audiences. The themes of this untranslated story are organized around four questions:

1. What is STEM learning and why does it matter?
2. Where do children learn STEM?
3. Why is it important to bridge children's STEM learning across different environments?
4. How can we better bridge children's STEM learning across different environments?

1. What is STEM learning and why does it matter?

- **STEM is a set of subjects oriented toward problem-solving and knowledge generation.** While experts noted differences in content and methods, all explained that the STEM subjects share a focus on learning how to gather and use evidence to answer questions and create knowledge.

- **STEM learning develops widely applicable, critical thinking skills.** Experts explained that, as people learn STEM, they develop skills that are valuable well beyond the four STEM subjects. Chief among these is a constellation of critical thinking and problem-solving skills. These skills are vital for learning other subjects, such as literacy, carrying out everyday activities, securing and maintaining professional success, and participating in and contributing to civic life.

- **Effective STEM learning is hands-on.** Experts explained that hands-on activities and experiences not only improve, but are also essential to successful STEM learning. Hands-on learning offers the opportunity for people to understand how STEM content applies in the real world and their particular interests. It also teaches the iterative process of exploration and experimentation that underlies the STEM fields. Experts also noted that making STEM learning an active process makes it more fun and, therefore, more engaging.

- **High-quality STEM education benefits both individuals and society.** Experts noted that STEM learning is especially important to civic engagement and participation and facilitates solving social problems. By equipping citizens with critical thinking skills and substantive knowledge, STEM learning enhances our understanding of the sources of social problems and our ability to develop innovative solutions that can address them. STEM learning also helps people better engage with social problems and make sense of policy debates. Experts further noted that STEM learning is critical to developing the future workforce and highlighted the importance of STEM proficiency for virtually all jobs.

2. Where do children learn STEM?

- **STEM learning happens in both formal and informal environments.** Experts asserted that children learn STEM whenever they ask and pursue answers to any question or problem. Thus, they explained that STEM learning can and does happen in the formal school setting as often as in more informal learning environments, like after-school and daycare programs, museums, libraries, summer camps, and at home.

- **Informal environments are essential to STEM learning.** Experts explained that informal settings allow children to pursue STEM learning as it relates to their personal interests, offer many opportunities for collaboration and hands-on learning, have flexible schedules, and don't employ formal evaluations. This flexibility and freedom greatly enhances children's STEM learning by making it relevant and fun.

- **The home is an especially important environment for STEM learning.** Experts asserted that the home plays a critical role in STEM learning. In part, this is because children, especially younger children, spend most of their time at home or with family members. As important, most of children's daily routines and experiences occur at home and, thus, learning STEM at home shows children the relevance of STEM to their daily lives and interests. For example, many experts pointed out preparing meals as a daily, collaborative, hands-on activity that readily lends itself to STEM learning. Finally, experts explained that the home is a valuable STEM learning context because children typically have greater autonomy to pursue their own interests at home and, ideally, also feel safer and more comfortable with learning at home than in other environments.

- **Opportunities for STEM learning vary along racial, socioeconomic, gender, and geographic lines.** Experts highlighted that children from lower-income families, children who are immigrants and/or non-English speaking, girls, children who live in rural areas, and children who identify as Black and/or Latino or Hispanic have less access to STEM learning in various kinds of environments than their counterparts. They noted that several factors explain these disparities, including differences in economic resources, language and communication barriers, cultural norms and beliefs about STEM learning, differential funding for institutions in different

geographic areas and that serve different populations, and a lack of flexibility in the curricula and standards used to evaluate learning in more traditional learning environments.

3. Why is it important to bridge children's STEM learning across different environments?

- **Different environments offer different resources and opportunities for children to learn STEM.** Experts argued that no single environment can provide everything that children need to learn STEM. Environments vary in both the type and amount of resources that are needed for STEM learning, such as expertise, technology, physical space, and individualized attention. In addition, different environments are governed by different cultural norms and expectations around learning. Notably, children are granted more or less freedom to engage in different kinds of learning in different environments, such as play, hands-on learning, and group-based learning.

- **Children learn STEM more effectively when it is connected across different environments.** Experts frequently argued that learning STEM in more than one environment greatly enhances STEM learning. They explained that different environments can deepen and build upon children's existing knowledge and skills and introduce and help children to develop new knowledge and skills. In short, learning in different environments enhances STEM learning by expanding and advancing, not simply repeating and reviewing, what children already know or learn in any one environment.

- **Learning STEM across multiple environments builds and maintains children's engagement and identification with STEM.** Experts asserted that encountering and connecting STEM learning across multiple environments shows children its relevance and wide applicability. Related to the previous points, by offering different resources and operating by different norms, children's environments vary in the extent to which STEM learning connects to children's goals and interests. For example, experts highlighted how different kinds of environments provide children with opportunities to engage and connect STEM topics and skills to things that they enjoy, such as dance, music, or fashion. When STEM learning is meaningfully connected across different contexts, children find value and take ownership of STEM learning. They also feel more comfortable, confident, interested in, and more likely to pursue STEM opportunities.

- **Ensuring opportunities in multiple environments reduces disparities in STEM learning.** Experts emphasized that ensuring access to STEM learning in multiple environments, particularly informal ones, has the potential to reduce disparities in STEM skills and knowledge. As described above, informal environments offer flexibility in the kinds of learning opportunities they offer and the norms by which they operate and evaluate learning outcomes. As such, informal environments help generate and sustain interest in STEM among children who belong to groups or communities that have been traditionally underserved by formal school environments.

4. How can we better bridge children's STEM learning across different environments?

- **Strengthen coordination and collaboration between formal and informal learning institutions.** Experts argued for building stronger connections between the different people and institutions that help children learn, such as schools, museums, libraries, and after-school programs. They highlighted a need to strengthen infrastructure and increase the availability of resources to help institutions more effectively collaborate and communicate with each other. Specific suggestions they offered included increasing funding for collaborative projects between different types of institutions and creating organizations and programs that can identify, connect, and coordinate the work of different institutions.

- **Support and engage parents as partners in children's STEM learning.** Experts highlighted that parents have considerable power over the places where children learn and the learning opportunities that they can access. This is especially true for younger children. Parents are thus key in facilitating a child's exposure to different STEM learning contexts and in drawing connections between the learning that takes place in these contexts. Experts said both schools and informal learning institutions must regularly reach out to and provide parents with knowledge and resources to support children's exposure to STEM learning. They can do this via websites, digital media, or written communications showing parents how to engage their children in STEM learning at home and how to relate it to STEM learning in other places.

- **Develop and enhance programming and resources in informal learning environments.** Experts advocated for improving STEM learning resources outside of the formal school environment. They argued that museums, libraries, and other institutions have programs and learning tools that engage children and teach parents and adults how they can help children learn STEM. This might include providing interactive, hands-on exhibits, makerspaces where children engage in hands-on activities, or opportunities to learn from and network with STEM professionals.

- **Ensure access to technology for children and their families.** Experts argued that technology is essential to connecting STEM learning for children and their families, especially those with fewer resources. Experts called for improving children's in-person access to STEM resources and environments. Technology, they noted, can help parents both connect to and learn from institutions involved in their children's learning. For example, parents can use digital applications to stay updated and communicate with schools and teachers about their children's progress; visit the webpages of schools, museums, libraries, and other institutions to learn about STEM content; or find ideas and activities they can use to help their children learn STEM at home and connect it to what they are learning about in other environments. Toward this end, experts supported public subsidization of high-speed internet and basic mobile devices, such as laptops or tablets. They also

cited the need to develop and increase funding for programs aimed at increasing digital literacy and skill-building among parents, families, and children, such as digital learning corps.

- **Allow greater flexibility in evaluations of schools and students.** Experts explained that, in general, education policies devalue or ignore out-of-school learning, which presents a barrier to connecting children's STEM learning across different environments. Many experts advocated for reforming policies to allow students to earn school credit for visiting or participating in activities and events held at informal learning institutions. They also suggested that schools and teachers be evaluated by the extent to which they provide opportunities for children to connect to out-of-school STEM learning opportunities, such as how frequently they take children to museums or bring real-life scientists into the classroom to teach and speak about their work.

- **Increase funding to conduct research on connecting STEM learning across environments.** Experts highlighted a lack of research about how children's STEM learning is currently connected across places and how to promote stronger connections. They argued that we need to learn more about the social, institutional, cultural, and technological supports that facilitate or impede connections across STEM learning environments.

The Public Perspective on Bridging STEM Learning Environments

This section details the dominant cultural models—the shared but implicit understandings, assumptions, and patterns of reasoning—that shape public thinking about STEM learning environments. These cultural models are ways of thinking that are available to the public. It is important to emphasize at the outset that people are able to think about STEM learning environments in multiple ways. People toggle between these models, thinking with different ones at different times, depending on context and conversational cues. Some models are dominant and more consistently and predictably shape public thinking, while others are more recessive and play a less prominent role in public thinking and easily pushed aside when more dominant ways of thinking come to mind. It's also important to note that different models offer different strategic advantages in the communications process—some models are productive and facilitate understanding of STEM learning environments and support for the policies and programs that experts recommend, while others are unproductive, impeding understanding and reducing support for solutions. In addition, this research located a set of "cognitive holes"—areas where the public lacks ways of thinking about an issue that must be filled in. By seeing the models available and locating the cognitive holes, communicators can frame their messages to activate productive models, de-emphasize unproductive ones, and fill in missing understandings with accurate, well-framed information.

Part 1: Cultural Models of Learning

To understand how the public thinks about STEM learning environments, it is important to first review the set of understandings that people use to think about how children learn.

The *Children as Sponges/Containers* Cultural Model

Frameworks' research shows that members of the public hold a strong model of child development and learning as processes of soaking up or being filled up with information.[2] The deep metaphor that shapes this thinking is that children are an empty space who learn simply by observing other people or receiving things from their environment. This is a highly passive model of learning, wherein children are considered like sponges or containers that absorb or take in whatever is around or presented to them.

> **Researcher:** How do you think children actually learn those things?
> **Participant:** Observation. I mean they are little sponges. They kind of learn.…[3] They have a free mind… So, they get to soak in everything, and they tend to interpret it in some ways, but then they're still learning, so they're still open to learn different ways.
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> **Participant:** Most kids learn schoolwork at school, unless they're home-schooled. And then, I guess they learn about whatever is presented to them. Whatever the parents or caregivers bring into the home, they learn. Some things maybe they shouldn't, but if they're exposed to it, then I think they tend to soak it up.

The *Instruction* Cultural Model

Although the public thinks of children as passive sponges, they also believe that adults must completely guide or control learning. Thinking with this model, people view learning as a unidirectional process wherein adults transmit information *to* children, whose role is to passively observe and receive the information provided. This model of learning is most strongly associated with school learning.

> **Researcher:** What about at school? What sort of activities are good for learning?
> **Participant:** I would say a lot of it would be instructional learning, where they're actually getting visuals from someone with like, a chalkboard and a whiteboard, or blocks. The teacher will often do blocks of 10 and then blocks of one to give them a visualization of how to count to, let's say, 13. One big block of 10, and then small blocks of three. Then, also paperwork. They'll get a lot of paper that will have the numbers written out there, how to identify them, the minus and the plus signs, and how to use them appropriately.

The *Interactivity* Cultural Model

In a seemingly contradictory way, when given different cues, members of the public can think about learning as a process of active and dynamic interactions between children and adults.[4] Thinking about learning in this way, people assume that children learn by directly interacting with and responding to people and experiences. In this way of thinking, children are active partners in the learning process who can learn anywhere they can be with other people and objects or experience the world.

Researcher: What kinds of things do you think you could do at home to teach a child about sharing?
Participant: Share with them when they ask you for something. And, if they have something, ask them for it. And, if they say no, then you can be like, "Well, that's not sharing."
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Researcher: What kind of activities are useful for learning at home?
Participant: At home, I would say that math is a key one that you need to work on. That has to do with even simple games like playing with their food, like, how many peas are on the plate? If you eat half your sandwich, asking them, "How much do you have left?" Then, going up from there and making games out of anything, like asking, "How many steps to your bedroom before you go to bed?" […] Just taking advantage of any opportunity to learn.

The *Interactivity* model was strongly applied by participants when thinking about STEM learning. When asked about how students learn STEM, people readily focused on building and creation, and assumed that STEM learning is fundamentally hands-on—that to learn STEM subjects and skills is to directly perform operations, experience and observe consequences, modify approaches, and try again. Notably, however, the public does not typically or always apply this model when thinking about math learning, which is more often governed by the one-way thinking of the *Instruction* cultural model described above.

Researcher: What do kids need in order to learn science?
Participant: You've gotta have projects, and you've gotta have hands-on types of experiences, like working with different types of chemicals and different types of materials. Not necessarily book-directed learning, but more hands-on type application.
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Researcher: What would be the best way to learn science, technology, engineering, and math?
Participant: […] Like I said, building stuff. A class where you could just build stuff, like building things off of prints for engineering. For science, having actual, real things going on, like in science labs and stuff like that.

The *Rechargeable Attention Battery* Cultural Model

Members of the public also think about learning as a process that drains the energy of children, like using up the charge of a battery. Children are understood to have a limited store of energy to expend on learning and, once this energy is depleted, they must be allowed to recharge through "downtime" and engaging in non-educational activities. This model sets up school as children's primary learning environment; it positions in-school learning as reasonably difficult, and out-of-school experiences as important for providing a break from learning. Thus, this model leads people to push back on the idea that out-of-school contexts can and should offer important and valuable learning opportunities.

Researcher: You mentioned your daughter getting overloaded. Can you say more about that?
Participant: In my experience, when she's confronted with too much learning, it tends to break her down. Often, she'll get to the point where she'll either say, "I'm stupid because I can't learn this," or she will just totally shut down and just say she can't complete it. Sometimes that's a bit challenging.
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Researcher: How would it affect kids if their learning was really interconnected between all these different places?
Participant: Hopefully, positively. Unless, it can also be too much. It's too much for a kid, too hard sometimes. […] And, it can be a little overwhelming maybe. Because there's too much going on, and they feel like, "Just leave me alone." So, I don't know.

The *Back to Basics* Cultural Model

This model assumes that the most important, and, in many cases, only things that children need to learn are "the basics." The basics are assumed to be reading, writing, and arithmetic. More broadly, this model assumes that learning is sequential and hierarchical—the basics must be learned well before anything else can be learned. Any other skills can and should only be learned after the basics have been mastered. When thinking with this model, people evalute learning in zero-sum terms, believing that children have a limited amount of time to spend on learning. From this perspective, increasing learning in one area (STEM), by definition, means decreasing learning in other areas that people see as more important (the basics).

> **Researcher:** Where would you place funding for making sure that STEM learning for children is connected across different places? Would you say that that should be like a high priority for funding, or low priority? Somewhere in the middle?
> **Participant:** I think it's number two and three. If I had a rating between one and five, let's say, it would have to be two and three. Because, of course, you have to have reading and everything that comes first. […] You want to make sure they have the basics to begin with, and then you can go from there.
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> **Researcher:** What do you think are the key things that children need to learn?
> **Participant:** The key things that I think they need to learn are reading, writing, and arithmetic—the fundamentals. Because, as a child develops, and as their brain develops, they're each going to acquire different skills. One may excel in math, and one may excel in reading, but you really have to have the fundamental bases to operate.

The *Highly Trained Expert* Cultural Model

People frequently assume that helping children learn requires an adult with formal training in teaching or deep mastery of a given content area. This model is frequently activated when people think about topics and skills they perceive as more specialized or advanced, and, thus, is a dominant way the public thinks about how children learn STEM—that STEM learning requires a teacher who is highly skilled and deeply experienced in a STEM field.

> **Participant**: If people lack education or anything, they're going to be a little intimidated by the STEM side of things, so they would just rather their child get it from somewhere else. They would have a fear of giving him the wrong information, or, like, looking inferior to your child, you know. You don't want your child to think you're slow or something.

The *Quality=Caring* Cultural Model

FrameWorks has consistently found that when members of public talk about how children learn, there is a strong tendency to narrowly focus on parents and school teachers. Furthermore, when doing so, they focus on a single quality of these individuals: their level of innate caring. People assume that children will learn as long as their teachers and parents care enough about them. Thinking in this way, people see failures or difficulties in learning to be the result of a lack of caring on the part of teachers or parents.

> **Researcher:** Are there specific people who stick out in your mind as especially important for helping children to learn?

Participant: I would say parents first. I think grandparents are important if they are there, but I do realize that family or people who love you do not have to be blood-related to you. And, so, I say anyone who has the heart to love a child, to really put everything good in that child. They are the people that are there.
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Participant: So, my last son learned about economics in first grade. He had a very young teacher, and so he was explaining his understanding of supply and demand. […] But, she formed it in such a way that I was very impressed. She may have only been like a second-year teacher, that was it. I was like, they have to bring more of her in there, or more of whatever she's drinking. She had, like, she had a passion. And when you have passion, that's the result that you will get.

In addition to these general models of learning, the public uses two more specific models to think about STEM learning. These models were used by participants when reasoning specifically about where STEM learning happens and are thus particularly relevant for communicators messaging about connecting STEM learning environments.

The *STEM Is Specialized* Cultural Model

There is a strong tendency among the public to see STEM as a set of highly advanced and specialized topics. When coupled with the *Back to Basics* model described above, people assume that STEM learning can and should only happen later in the learning process—after more basic skills and knowledge have been mastered—and, even then, only for those children who have displayed a proclivity for these subjects.

Participant: […] Seems like STEM would be more advanced. I think of it more as advanced schooling. Even though I'm not familiar with STEM, it sounds like a more advanced type of school.
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Participant: Sometimes, if you're getting too much too early and advanced, I think it's too hard. It gets them away from being a kid. Those things [STEM] are a little higher up on the educational line. […] So, if they're doing it when they're too little, I don't know if that's good.
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Researcher: When you think about STEM learning, science, technology, engineering, and math, what comes to mind?
Participant: Difficulty… I mean, engineering, wow. That sounds like it's for an adult. That's what comes to mind.

The *STEM as Everyday Necessity* Cultural Model

The public also assumes that some STEM skills and knowledge are necessary to complete everyday activities and tasks. Many interview participants noted how STEM learning provides children with skills and knowledge essential to success. Thinking in this way, people see STEM learning as important because it enables people to effectively navigate the world and overcome challenges.

Researcher: If a kid learns STEM really well, what are the effects of that?
Participant: One of the things that it would instill in children is that they can overcome any challenge, like when you present them with bigger challenges and they can overcome them. It helps as far as their reasoning in the future—that they're actually gonna want to learn something and be able to figure it out, rather than just accept it for the way it is.
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Researcher: Would you say that STEM learning is important?
Participant: It's important. I mean, some people are not good at that, but I think it's still important to learn.
Researcher: Why?

Participant: Because there's a lot of different things in life that you'll need that kind of stuff for. And if you don't at least know any of the of basics of it, it's gonna be hard.
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Researcher: Should kids learn STEM?
Participant: Sure. For sure.
Researcher: Why?
Participant: Why not? It's all in your home, a lot of these things that we're discussing. It's good to learn. It's good to learn how to put something together. […] Like I always say, "The more you know, the better," because you save yourself a lot of grief when you know how to do something.

Communications Implications of Cultural Models of Learning

1. **The *Children as Sponges/Containers* and *Instruction* models undermine thinking about the need to connect STEM learning opportunities.** These models frame learning as an automatic, natural, and passive process. As a result, while people can see a need to expose children to multiple environments, they do not see any need to meaningfully connect or integrate learning across all of them, or to build in opportunities for active engagement in all learning contexts. If children are sponges or containers who learn through a top-down process, exposure is enough. Communicators should be careful not to inadvertently use language or imagery suggesting that learning is a passive activity of adults passing on content or skills to children.

2. **The *Interactivity* model can increase support for STEM learning in informal environments.** With the right cues, people can see hands-on experience as essential to children's STEM learning. Because of this, this model facilitates support for informal learning contexts, which they associate more with hands-on learning. When drawing on this model, people can see the power of having children learn STEM by giving them the freedom to explore subject matter and dig deeper into the problems that interest them most. Activating this model thus provides a strong foundation for translating the expert account of STEM learning environments. Communicators can cue this model by focusing on language and examples that show the experiential and hands-on activities that facilitate STEM learning.

3. **The *Rechargeable Attention Battery*, *Back to Basics,* and *STEM Is Specialized* models limit people's thinking about where and when children should learn STEM.** These models undergird one of the public's primary critiques of STEM and informal learning—that STEM learning is too advanced for younger children, and that both STEM and informal learning take away from learning other, more important skills and subjects, or drain children's attentional resources. This leads people to view STEM learning as something that should happen only in school, after the basics, and for children who excel or are uniquely interested in it. Unfortunately, these models are easily cued by longstanding practices in educational discourse—language that frames attention as a limited resource, basics as paramount, and STEM as highly technical and specialized. This research suggests the ongoing need to use alternative ways of talking about attention, engagement, and the relationship between STEM and other skills.

4. **The *Quality=Caring* model limits understanding of how learning can be improved.** Thinking with this model pushes the myriad issues that affect learning out of public thinking, like the design of curricula and physical learning spaces, and the availability of different types of learning opportunities.

Communicators must take care not to cue this model and, instead, should clearly explain and provide examples of the wide range of factors that support STEM learning.

5. **The *Well-Trained Expert* model limits the adults, contexts, and activities that people can see as potentially effective for STEM learning.** In contrast to the *Quality=Caring* model, this model defines quality in terms of resources like experience and training. However, the assumption that formal qualifications are essential to student learning leads people to prioritize learning from teachers and at schools, and to devalue the role of others (and other places) in the learning process. Thus, communicators must explain how people other than teachers can contribute to children's learning and expand people's thinking to include resources in addition to formal training and professional experience that can support all adults in helping children learn.

6. **The *STEM as Everyday Necessity* model expands the perceived value of STEM and directs attention toward informal environments.** When the public focuses on everyday activities that involve STEM, they see STEM learning as occurring in and relevant to a range of contexts and find value in learning STEM outside of the school environment. In addition, this way of thinking leads to the belief that the sooner and the more that children learn STEM, and the more places they encounter and engage with it, the better. This model can be cued by emphasizing the practical, everyday applications of STEM skills, a tactic that is already in use by the field but that this research suggests should be applied with even greater frequency and creativity.

Part 2: Cultural Models of Technology and Learning

Analysis showed a set of common assumptions and understandings that shaped how participants thought about the role of technology in children's learning.

The *Technology as Artificial Distraction* Cultural Model

Most dominantly, the public models technology as something that prevents or blocks children from engaging with things and people in the "real" world. When modeled in this way, technology is thought of as artificial and antithetical to real, authentic engagement and learning. It is understood to isolate and disconnect children from learning, which is assumed to happen best through direct, in-person engagement with people and nature. Thus, this model leads people to see technology as impeding or distracting children from learning and makes it difficult for them to see how it can facilitate learning.

Researcher: Should technology be used in schools? And if it were, how do you think it should be used?
Participant: Yes, I do think it should be used. But, I think it gets away from the human contact. So, I think if you just go, "Okay, get on your computer and look." […] It's like, where did the teaching and the interaction and all that go?
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Participant: I'm a very hands-on learner, so I don't really like to just look at something while I learn it. I like to have examples or interact, rather than just staring at a screen. When I take classes, it has to be in a physical classroom, writing physical notes, and all that stuff.
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Researcher: Do you think there are some examples of how the internet can teach kids stuff?

Participant: You're not actually interacting with anybody on the internet. So, I don't believe that's a good way to learn. I feel that being in the presence of somebody is learning. A teacher teaching you. It's better to have interaction with somebody rather than using the internet.
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Participant: I don't know. I'm not a big fan of video games, so I don't think it could be beneficial. […] I feel like it's kind of distracting to learning.

The *Engaging Technology* Cultural Model

This less dominant way of thinking about technology foregrounds interaction and responsiveness as key features. This model applies primarily when people think about digital games and applications that are explicitly about learning, or designing, such as Minecraft. The model focuses people's attention on the ways in which technology can facilitate children's learning by increasing their interest and engagement with content.

Participant: It's probably easier for children to learn if you can incorporate whatever it is they're meant to be learning into a game that they are definitely more inclined to play, versus just listening to you, you know?
Researcher: What about apps and things like that?
Researcher: You think they could help?
Participant: Yeah, I think they're a little more interactive, and kids like it—they're like obsessed with it.
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Participant: I would say there can be more interactive homework for the parents and the children. […] You had mentioned different types of apps. Instead of maybe getting paper homework, their homework can get put onto an app, and that's more interactive learning. Like, if they're learning counting, why do they have to look at a piece of paper when they could actually see 3-D visuals of numbers and different things? That would help them be more interested in it.

Communications Implications of Cultural Models of Technology and Learning

1. **The *Technology as Distraction* model blocks understanding of how technology can enhance and deepen learning.** When cued, this model leads people to see that learning with technology is, at best, shallower than learning through other methods. More importantly, the model leads to a view in which technology is an active impediment to learning. Communicators seeking to position technology as a tool in connecting learning should be careful not to inadvertently activate this way of thinking by, for example, practicing myth-busting or directly referencing misperceptions about technology in attempts to refute or correct them.

2. **The *Engaging Technology* model is more productive for communicators.** When people recognized technology as responsive to children's input, and when engagement is viewed as fundamental to effective learning, the public can more openly consider the positive role that technology might play in learning and, specifically, in connecting learning environments. Communicators should develop messages that foreground this way of thinking by emphasizing the ways in which technology responds to and can increase children's engagement with learning content.

3. **Communicators must expand how the public understands the role of technology in children's learning.** When thinking about the role of technology in learning, people assume that technology is primarily a tool that children use by themselves to learn specific things. People do not readily think about how technology can be used with others, or how it can be used to enhance learning in other ways, such as functioning to connect children and their families to learning environments or learning environments themselves. These ideas are simply not on the public's radar and represent a "cognitive hole" that communicators should attempt to fill with examples and explanations of how technology can achieve these functions and play these roles.

Part 3: Cultural Models of Learning Environments

Several important, overarching models were found to structure public thinking about where children learn and about the relationship between these contexts.

The *People Not Places* Cultural Model

When thinking about where children learn, people focus most readily and, in some cases, exclusively on people, rather than physical environments, or non-human resources. This model assumes that children learn from those who are directly and routinely involved in their lives, and that the personal qualities of the people involved almost wholly determines the quality of children's learning.

> **Researcher**: When you say you learned outside of school, where did you learn?
> **Participant**: Where did I learn? From my grandfather, originally, and from my uncle.
> --
> **Researcher:** When you think about where children learn, what comes to mind?

Participant: I would definitely say whoever raises them. I know I picked up a lot of things by being raised by my mom and my cousins as well.
--
Researcher: Coming back to kids, three to 12-year-olds, when they're learning, what are the physical locations where they learn?
Participant: I think the best place they learn is through their family.

The *Home and School* Cultural Model

To the extent that members of the public consider actual physical environments, there is a heavy focus on two locations—home and school. These two environments are assumed to be more important than any other for children's learning.

Researcher: Home and school. Any other places come to mind where children learn?
Participant: Children are always learning, but I think the basic places would be home first, then school.

The *Libraries as Book Storage* Cultural Model

When asked specifically about libraries, a dominant model was evident. Participants largely understood libraries as depositories for physical informational resources, namely books and newspapers, and, thus, to have little value in contemporary society, given technological advances. With this specific mental image and narrow focus in mind, people assume that libraries are outdated and best suited for solitary learning, and not as especially helpful or necessary to children's STEM learning.

Researcher: Do you think libraries are a place where children can learn about science, and math, and technology?
Participant: They're just gonna get on a computer and learn the same thing they would in a library. I would miss it if libraries went away, but I think people don't use them anymore. Everything they use in science, you can get on the computer.
--
Researcher: What about libraries?
Participant: Libraries to me are somewhat antiquated, where the technology is just not as prevalent as it would be at home even. Books are an essential tool for learning, but with all the digital media that we have today, paper and books are somewhat a thing of the past. I believe in a little modernization, and I just don't necessarily like the quiet, sterile environment of a library.

The *Museums Are Flexible* Cultural Model

Analysis also revealed a specific model of museums as being interactive, and diverse and flexible in purpose and function—an almost wholly different way from how libraries were often understood. Thus, even while the public most readily associates museums with art and history, they also recognize and are very open to the idea of museums as places where children can effectively learn a wide range of content and skills in a variety of ways, including STEM learning.

Researcher: What role do you think museums play in children's lives?

Participant: Some museums create more curiosity. So, kids can see things there, and they may want to do more research on how this came to be. […] Like, for instance, the bodies exhibit; my kids absolutely loved it. So, I think it just depends on how much they update the museum to pique kids' curiosity.
--
Researcher: What kind of learning do you think happens in a museum?
Participant: There's millions of things you can learn at the museums here in Chicago. […] There's the Field Museum, [the Museum of] Science and Industry. My sons like the prehistoric things, so, of course, they read everything about that and learned that. They had an exhibit on King Tut. They could go in a submarine.

In general, participants rarely raised the idea of relationships between different learning environments, or bridging. Nevertheless, at various points, analysis revealed a set of assumptions that participants used to think about relationships between learning environments.

The *Extra Dose* Cultural Model

There is a dominant assumption that the role of out-of-school environments—typically home—is to give kids an "extra dose" of whatever they are learning in school. In this model, connecting learning is seen to be initiated and directed by schools, which provide guidance, usually to parents, about how they can reinforce school lessons in other contexts.

Researcher: Imagine that a kid has this experience where everything, all their learning environments are connected. What do you think is the effect of that on that kid's learning?
Participant: In that situation, the learning's being reinforced. So, it's giving them different aspects of the same thing that they were trying to learn. […] It's not just learning one thing in one place, and then moving on to the next somewhere else, because a lot of things are potentially forgotten.
--
Participant: Like even with cheerleading or karate after school, it could kind of just reinforce whatever they learn at school that day.

The *Filling in the Gaps* Cultural Model

In this alternative model of the relationship between learning locations, people assume that children need to learn about different things from different places. In this way, connecting learning environments is a means of providing children with something that they can't get as much of from another learning context.

Participant: I think that's pretty much how they can connect. You can pull some from here, pull some from there, and even if you don't get the answer at home, you can get it at school, you know. If you don't get it at school, maybe you can get it at the library or the museum.
--
Participant: I think everyone picks up a little bit of something different from everywhere. From school, museums, at home. It's like building. You're not going to learn everything in one place.

The *Breaking Up the Routine* Cultural Model

The public also sometimes assumes that the value of learning in different environments is simply to avoid boredom and increase engagement. This model is especially salient when thinking of the relationship between learning at school in relation to other places. When thinking in this way, people see the purpose of informal environments as breaking up a presumably boring routine of school learning.

> **Researcher:** Do you see field trips to some of the places you mentioned as important places for kids to learn?
> **Participant:** I think so. They get some time outside their box, and see different things, but also, it breaks up the day. It's very mundane to sit in a classroom day after day and having the same things over and over.
> --
> **Participant:** I think kids learn a lot more by engaging in other places than just sitting in a classroom all the time. I think sometimes that gets totally mundane.

The *Home/School Divide* Cultural Model[5]

The public generally holds two models of the relationship between home and school learning. This model assumes that home and school are fundamentally different—that each is good for learning different things in different ways. Home learning is primarily about values, while school is about academics. Relatedly, the model assumes that parents and teachers have different competencies and concerns that align with these topics.

> **Participant:** Parents aren't gonna really go over math and science while they're at home. I don't think I would be up to snuff on trying to teach a child on any level right now. I'd be like, "What? What is that?" I do think that they're gonna have to learn academics and stuff like that in school instead of at home.
> --
> **Researcher:** So, what type of things do you learn at school?
> **Participant:** At school? More academics. Reading. Writing. Stuff like that.
> --
> **Researcher:** What kind of stuff do they learn at home?
> **Participant:** How to survive. How to take care of your family. How everyone should be there for each other. They learn the basics of life. I know school and all that is important. You learn or whatever at school, but half the stuff I ever learned at school applies nothing to me now in my everyday life.

The *Home-School Ladder* Cultural Model

Instead of as separate and distinct, this model figures home and school learning as a sequence. By this way of thinking, a child's learning begins at home and is picked up or completed at school. Parents teach children the most basic content, and then hand things off to schools where instruction and topics are more advanced.

> **Researcher:** How would you describe what children learn in school?
> **Participant:** Well, I would say… you can teach the child the basics of math, and then they go to school, so they can improve on those functions. You can also assist them when you work with them on their homework and other activities that they have. It's more of a sharpening skill at school.

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Participant: Learning always starts at home. And, I think school then just kind of opens up the other doors to like… how to build those little Legos into cars, and then how those components become cars and things that we use in everyday life.

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Researcher: When you think about where children learn, what comes to mind?

Participant: First, at home. I would say the foundation and fundamentals of where a child learns are first taught by parents, and then I would say corrected or improved on at school.

Communications Implications of Cultural Models of Learning Environments

1. **The *People Not Places* and *Home and School* models leave out many of the places where children learn, and minimize the importance of physical features, resources, and connections between learning environments.** People do not immediately recognize the importance of learning in different environments, especially when places are not as strongly associated with the individuals that people most strongly attach to the learning process (i.e., parents or teachers). This leads to both an incomplete understanding of learning and a lack of appreciation for the power of connecting and integrating formal and informal learning contexts. Communicators must explain the importance of different physical spaces in the learning process and provide examples of how connecting them enhances STEM learning.

2. **Communications about environments other than the home and school must address specific challenges.** People's dominant focus on the home and school means that messaging about the importance of other learning contexts, and of the connections between them, requires special attention. Communicators must be aware of the challenges and opportunities attached to particular learning contexts. For example, communications about libraries must address and expand people's thinking about their functions and potential role as valuable and important locations for STEM learning. In contrast, when messaging about museums, communicators can cue the flexibility and interactivity that members of the public already associate with this context.

3. **People's thinking about connecting learning contexts focuses on home and school.** A defining feature of how people think of the relationship between learning contexts is the centrality of home and school. Even models that lead to more productive ways of thinking about the relationship between home and school obscure the role of many of the environments that experts view as essential to effective STEM learning. Communicators must strongly focus on expanding the set of contexts that people see as important to children's learning and that need to be connected.

4. **The *Extra Dose* model increases support for connecting learning contexts but establishes a shallow understanding of *why* contexts should be connected.** While this model sets up a positive view of connecting learning locations, at a deeper level it structures a less than productive view of the relationship between contexts—where connecting is important for simply repeating and reviewing school learning in out-of-school environments. The model does not lead people to acknowledge how connections between informal contexts can advance or deepen learning, nor how other environments can initiate and help schools guide learning, rather than simply following schools. Nevertheless, whether this model can be expanded to facilitate a richer and more dynamic relationship between learning contexts is an open, empirical question.

5. **The *Filling in the Gaps* model is promising.** Thinking in this way helps people recognize that children can learn different things and in different ways in different places. This assumption leads people to see the value in providing a range of learning opportunities in a range of settings and of the importance of connecting such settings to build on one another. Activating this model can help communicate the power of connecting and integrating learning across contexts.

6. **The *Breaking Up the Routine* model undermines the importance of informal learning environments.** While this model facilitates a positive view of informal learning environments, it does not expand people's thinking about bridging to include advancing and deepening learning. In fact, by positioning informal environments *against* school, this model reinforces the *Rechargeable Attention Battery* model and leads to a view of informal environments as places where children should actively disengage from learning. In this way, this model ultimately denigrates the value and role of informal contexts and communicators should avoid cueing this model.

7. **The *Home/School Divide* model impedes support for connecting learning environments.** By positioning the functions of home and school learning as necessarily separate, this way of thinking prevents people from seeing the value of connecting these contexts. Communicators should be careful not to cue the idea that the goals and skills learned in different environments are fundamentally different from one another. Rather, messages should focus on the common skills and values that develop across different environments.

8. **The *Home-School Ladder* model provides an opening to build understanding of the relationship between home and school learning.** This model allows people to acknowledge a relationship between learning at home and at school. However, it positions this relationship in both hierarchical and uni-directional terms, where learning at home and parental expertise is more limited than at school and formal expertise, and where school learning can build on home learning but not the other way around. As with the several of the other models discussed in this section, the extent to which this model can be recruited and expanded in order to build a less hierarchical and more dynamic understanding of the relationship between home and school learning is a question for subsequent research.

Mapping the Gaps: Key Communications Opportunities and Challenges

This section notes overlaps, and "maps the gaps" between the expert and public perspectives to reveal communications challenges and opportunities in framing connections between STEM learning environments.

Overlaps

There are important points of overlap between expert and public understandings of STEM learning environments. These overlaps represent common ground that communicators can build on to communicate key ideas about STEM learning environments and increase support for programs and policies to bridge them. Both experts and the public understand that:

- STEM learning facilitates problem-solving skills and helps people navigate through and advance in life.
- Hands-on activities enhance STEM learning.
- Technology can be interactive and helpful to STEM learning.
- Informal learning environments enhance STEM learning.
- Different environments offer different learning opportunities.
- Home and school are essential learning environments.
- School learning can be connected to learning at home.

These are areas where expert ideas are productively aligned with public thinking; communicators can build on this common ground to shift thinking in new directions.

Gaps

There is also a set of significant gaps between expert and public understandings of STEM learning environments. Reframing strategies that address these can shift and expand the public discussion about STEM learning environments and the importance of bridging them. Future communications research will develop and test specific frames to address and close these gaps, including values, metaphors, names, and explanatory tools, and others.

1. **Where, when, and with whom does STEM learning happen: Anywhere, anytime, with anyone vs. In school, later on, with teachers**. Experts believe that children can learn STEM in almost any context, early in life, alone or with various people. In addition, they see a range of different environments and actors as important in this process. Even while acknowledging that STEM learning is hands-on, members of the public still tend to think that most STEM subjects should be

introduced later in life in school and ascribe more importance and responsibility to schools and teachers than to other environments and actors.

2. **STEM learning environments: Multiple pathways of influence vs. Environments as people.** Experts note that various aspects of environments shape STEM learning processes and outcomes, including resources, physical design, and norms. Members of the public do not readily recognize many of these aspects or directly connect them to learning. Instead, they focus on people, and their characteristics and qualifications, and overlook how non-personal features shape children's STEM learning and adults' teaching abilities.

3. **Informal learning environments: Essential vs. Non-essential.** Experts and members of the public agree that informal settings *can* foster student engagement by taking pressure off younger people and giving them the chance to explore and engage with STEM subjects. However, while experts see informal contexts as equally important parts of a larger "learning ecology," members of the public attribute supplementary and secondary roles to these spaces—placing them on a learning hierarchy well below formal classroom learning.

4. **Bridging: Reinforcing, deepening, and advancing learning vs. Repeating and reinforcing content.** Experts articulated bridging as a two-way, mutually reinforcing vision of the relationship between formal and informal learning environments. They explained that informal learning environments provide an alternative modality in which students can engage in subjects and bring concepts from formal learning to the real world. This learning can then be brought back into and guide learning in formal settings to sustain interest and increase engagement. In contrast, partly because they see informal environments as supplementary, the public largely undervalues connecting and integrating learning between different types of environments. When they do think about relationships between environments, they tend to place schools at the center and focus on how other learning in other environments can reinforce or review learning in school.

5. **Parents: Essential partners vs. Limited followers.** Experts see parents and caregivers as one of the most important and influential sources of children's STEM learning. They believe parents are in a good position to help children learn STEM and to work with and provide input to teachers and other educators. The public agrees that parents are important. However, they are wary about parents' abilities and interest in directly helping their children learn STEM and tend to feel that parents should take direction from others.

6. **Technology: Multi-purpose asset vs. Single-purpose, mixed blessing.** Experts see technology as a powerful learning tool that children and adults can use with one another to access content, people, and places. Technology is also seen as a way to help family members and learning institutions connect with one another. In contrast, the public primarily views technology as a source of content that children can use on their own. They are also ambivalent (at best) about the use and influence of technology, worrying about the role of technology in undermining social connections and distracting children from the things in life that matter most. Thus, to the public,

access to technology is something that must be restricted and curtailed rather than actively promulgated or subsidized.

7. **Supporting STEM learning: Multi-collaborative partnerships between different environments vs. Schools take the lead.** Experts advocate for blurring the lines between schools and communities and support creating and funding a range of collaborative, service, and mentorship positions and relationships, such that students can experience continuous learning in and out of the school environment. When thinking about solutions to improve STEM learning, members of the public focus almost exclusively on schools and on how they can increase motivation among parents and students.

Conclusion: Key Reframing Tasks

A systematic assessment of where and how public thinking differs from expert consensus is a crucial resource for setting communications priorities and designing a strategy to meet them. In this section, we offer a summary of the framing strategy that emerges from the research described above.

1. **Explain how learning STEM across multiple environments can *advance* and *deepen* children's STEM learning.** The most fundamental challenge for communicators of bridging STEM learning environments is redefining and explaining what connections between STEM learning environments should look like. An effective reframing strategy must show the public that connecting learning across different environments is about much more than reviewing or helping children to stay on top of school learning.

2. **Expand understanding of how different environments can contribute to children's STEM learning**. Concretizing the public's understanding of what makes an ideal environment for STEM learning and what a STEM learning environment can and should look like can help generate greater understanding and support for intentionally designing and connecting opportunities for STEM learning across different types of environments.

3. **Broaden understanding of how technology can be used to facilitate STEM learning and its relationship to hands-on learning opportunities.** The public's positive modeling of hands-on learning suggests the potential power of communications that constructively link it with technology. In particular, communications that highlight or provide examples of the boundary-defying and multi-locational affordances of technology might help to diversify the roles that the public most readily assigns to children's use of technology. They should provide examples of how these features can be used by adults to help integrate and facilitate children's STEM learning.

4. **Explain how the different environments and people from which children can learn can work as *partners* in children's STEM learning.** Apart from integrating and showing the importance of

other environments and people, an important task of reframing the issue of bridging STEM learning environments will be to ascribe a different role to non-school environments and people other than teachers. This will be difficult given the strong tendency among the public to position schools and teachers as better suited and more responsible for STEM learning than others—in other words, the linchpin of learning and the gatekeepers of content. Communicators must draw on values and examples that clearly illustrate the ways in which collaboration between different types of environments and people is both desirable and essential to helping children learn STEM.

Directions for future research emerge from the preceding systematic analysis of areas where expert views contrast with existing public understanding. In the next phase of work, researchers will use tested techniques and tools for reducing misunderstanding, promoting consideration of STEM learning environment experts' insights, and expanding the public's sense of what to consider as they weigh public options.

Appendix: Research Methods

Expert Interviews

To explore experts' knowledge about the core principles of STEM learning environments, FrameWorks conducted 10 one-on-one, one-hour phone interviews with participants whose expertise included research, practice, and policy. Interviews were conducted from July through September of 2017 and, with participants' permission, were recorded and transcribed for analysis. FrameWorks compiled the list of interviewees, who reflected a diversity of perspectives and areas of expertise, in collaboration with the Joan Ganz Cooney Center.

Expert interviews consisted of a series of probing questions designed to capture expert understandings about how and where children learn STEM, how STEM learning environments are related, and what needs to happen to support and improve connections between different STEM learning environments. In each conversation, the researcher used a series of prompts and hypothetical scenarios to challenge experts to explain their research, experience, and perspectives; break down complicated relationships; and simplify complex concepts. Interviews were semi-structured in the sense that, in addition to pre-set questions, researchers repeatedly asked for elaboration and clarification and encouraged experts to expand upon concepts they identified as particularly important.

Analysis employed a basic grounded theory approach. Researchers categorized common themes from each interview. They also incorporated negative cases into the overall findings within each category. This procedure resulted in a refined set of themes, which researchers supplemented with a review of materials from relevant literature.

Cultural Models Interviews

The cultural models findings presented in this report are based on a set of interviews with members of the public, supplemented by a review of Frameworks' past work on informal STEM learning and digital media and learning.[6] To understand the public's current thinking, FrameWorks conducted 10 in-person, in-depth interviews with members of the public in July 2017 in Atlanta, GA, and Chicago, IL. In the past work used to supplement this report, FrameWorks conducted 41 in-depth interviews with members of the public in 2010 and 2013 in Atlanta, GA; Chicago, IL; Jacksonville, FL; Knoxville, TN; Los Angeles, CA; Philadelphia, PA; San Jose, CA; and Wolfeboro, NH. Thus, the findings in this report are based on a total of 51 interviews conducted in eight different locations in the United States.

Cultural models interviews—one-on-one, semi-structured interviews lasting approximately two hours—allow researchers to capture the widely shared, patterned sets of assumptions (i.e., "cultural models"), that participants use to make sense of a concept or topic area. These interviews are designed to elicit ways of thinking and talking about issues—in this case, issues related to bridging STEM learning environments.

Interviews included in this analysis covered general thinking about learning and learning environments, STEM learning, technology and digital media, and other themes.

The goal of these interviews was to reveal the cultural models that participants use to make sense of these issues and how they relate to one another, so researchers gave participants the freedom to follow topics in the directions they deemed relevant. Researchers approached each interview with a set of topics to cover but left the order in which these topics were addressed largely up to participants. All interviews were recorded and transcribed with participants' written consent.

By interviewing a wide range of people, researchers could identify cultural models that represent shared patterns of thinking across the United States. Participants were recruited by a professional marketing firm and selected to represent variation along the domains of ethnicity, gender, age, residential location, educational background (as a proxy for socioeconomic status), political views (as self-reported during the screening process), religious involvement, and family situation (married, single, with children, without children, age of children). The professional marketing firm extensively screened participants to ensure the sample was balanced and diverse according to the project specifications but did not reveal the topic of the interview. It was important that the participants came to the interview without having done any preparation, so researchers could establish their baseline thinking about the relevant issues.

To analyze interviews, researchers used analytical techniques from cognitive and linguistic anthropology to examine participants' understanding of the relevant issues.[7] First, researchers identified common ways of talking across the sample to reveal assumptions, relationships, logical steps, and connections that were commonly made but taken for granted throughout an individual's talk and across the set of interviews. In short, the analysis is about patterns discerned from both what was said (how things were related, explained, and understood) and what was not said (assumptions and implied relationships). In many cases, analysis revealed conflicting models that people brought to bear on the same issue. In such cases, one of the conflicting ways of understanding was typically found to be dominant over the other, in the sense that it more consistently and deeply shaped participants' thinking. In the analysis, FrameWorks prioritized more recent interviews focused on the specific topic of bridging STEM learning environments; interview excerpts from past work were used to primarily confirm or contextualize the findings presented in this report.

Analysis centered on ways of understanding that were shared across participants. Cultural models research is designed to identify common ways of thinking that can be identified across a sample. It is not designed to identify differences in the understandings of different demographic, ideological, or regional groups; this would be an inappropriate use of this method and its sampling frame.

About the FrameWorks Institute

The FrameWorks Institute is a nonprofit think tank that advances the nonprofit sector's communications capacity by framing the public discourse about social problems. Its work is based on Strategic Frame Analysis®, a multi-method, multidisciplinary approach to empirical research. FrameWorks designs, conducts, publishes, explains, and applies communications research to prepare nonprofit organizations to expand their constituency base, build public will, and further public understanding of specific social issues—the environment, government, race, children's issues and health care, among others. Its work is unique in its breadth, ranging from qualitative, quantitative and experimental research to applied communications toolkits, eWorkshops, advertising campaigns, FrameChecks® and in-depth study engagements. In 2015, it was named one of nine organizations worldwide to receive the MacArthur Foundation's Award for Creative & Effective Institutions. Learn more at www.frameworksinstitute.org.

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Learn more at joanganzcooneycenter.org/FamLABProject.

Endnotes

[1] Quinn, N., & Holland, D. (1987). Culture and cognition. In D. Holland & N. Quinn (Eds.), *Cultural models in language and thought* (pp. 3–40). Cambridge: Cambridge University Press.

[2] See, for example: FrameWorks Institute, "Framing Early Child Development Message Brief." (2009). Washington, DC: FrameWorks Institute; Bales, S. N. (Ed.). (2013). *Talking child well-being and public health in Jacksonville: A FrameWorks MessageMemo.* Washington, DC: FrameWorks Institute; O'Neil, M., and Haydon, A. (2016). *Reframing early childhood development and learning in Alamance County: A FrameWorks core story brief.* Washington, DC: FrameWorks Institute.

[3] Bracketed ellipses indicate that editors have removed quoted material for brevity and context.

[4] It is critical to keep in mind that the public can hold multiple, seemingly contradictory models of STEM learning and learning environments, which is a pattern that is by no means exceptional to these issues—conflicting and contradictory assumptions applied in understanding the same issue are relatively normal in the "swamps" of cultural models. These apparent contradictions demonstrate a basic feature of how people make sense of information; we apply existing categories and mental structures to process and make sense of incoming information—what is referred to as the top-down nature of cognition. Because sets of assumptions and understandings come prepackaged and are not generated anew to best-fit new information, two different mental models may become active in thinking about and making sense of the same issue even without necessarily appearing consonant with one another.

[5] In previous research, FrameWorks has found the public holds a *Compartmentalized Learning* model where people assume that what happens in school should be insulated and kept separate from the outside world. See: Kendall-Taylor, N., Lindland, E., & Baran, M. (2012). *Mapping the gaps on where and when learning takes place: A core story of education report.* Washington, DC: FrameWorks Institute; Bales, S.N., & O'Neil, M. (Eds.). (2014). *Putting it back together again: Reframing education using a core story approach: A FrameWorks MessageMemo.* Washington, DC: FrameWorks Institute.

[6] See: Volmert, A., Baran, M., Kendall-Taylor, N., & O'Neil, M. (2013). *"You have to have the basics down really well": Mapping the gaps between expert and public understandings of STEM learning.* Washington, DC: FrameWorks Institute; Kendall-Taylor, N., & Lindland, E. (2010). *"It's just a fancier book": Mapping the gaps between the expert and the public understandings of digital media and learning.* Washington, DC: FrameWorks Institute.

[7] Quinn, N. (Ed.). (2005). *Finding culture in talk: A collection of methods.* New York, NY: Palgrave Macmillan.