

ADVANCING THE CONVERSATION

on Scaling National Informal STEM Programs



Guidelines for Equitably Scaling Informal STEM Programs

Guidelines for Equitably Scaling Informal STEM Programs outlines the contextual issues around scaling informal STEM programs, discusses the limitations of current frameworks for scaling, and provides six guidelines to consider for equitable scaling.

Practitioners can also utilize the companion document, ***Collaborative Decision-Making Tool for Equitably Scaling Informal STEM Programs***, to begin implementing the guidelines. This decision-making tool provides a starting place for those interested in applying these ideas to their practice.

The guidelines and tool are not intended as how-to guides on program scaling. Rather, they serve to empower people to engage in conversation and ask critical questions related to equity and scaling.



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**National Girls
Collaborative
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DEFINITIONS

Many definitions exist for the terms below. Following is how they are used in the context of the guidelines.

Equity: A process of consistently reflecting on, evaluating, and disrupting broader systemic barriers and biases that implicitly and explicitly exclude people from participating in order to ensure that everyone has what they need to thrive.

Implementers: Site directors, coordinators, and educators working directly with youth in informal learning settings, such as afterschool programs, museums, libraries, and other community-based organizations.

Informal STEM learning: Science, technology, engineering, and math education opportunities and experiences that occur outside the classroom in settings such as museums, afterschool programs, libraries, and other community-based settings.

Practitioners: Individuals who actively engage in the design, facilitation, and implementation of STEM education activities, programs, and experiences in informal learning environments. Practitioners may include both implementers and program developers.

Program developers: Individuals who conceptualize and design informal STEM learning curricula, programs, or experiences. These individuals may work in museums, universities, corporate outreach departments, and other community-based organizations.

Scaling: The process of taking a curriculum or program that has shown positive impacts in one context and spreading, replicating, or reproducing it in other informal learning contexts to reach more people and maximize impact (Dede & Rockman, 2007; Koch & Penuel, 2010).

OVERVIEW

In 2023, the National Girls Collaborative Project (NGCP) and Education Development Center (EDC) collaborated with informal STEM learning practitioners to co-design *Advancing the Conversation on Scaling National Informal STEM Programs*, a conference to examine current frameworks and conceptions of scale in informal STEM learning. This conference convened and elevated voices commonly missing from scale-related conversations: the people who work directly with youth and families to provide informal STEM learning programs.

The following document offers a set of guidelines for equitably scaling informal STEM programs identified and developed by conference participants—the practitioners involved in receiving, developing, and studying “scaled-up” initiatives. Co-written with practitioners from across the informal STEM learning field, these guidelines are designed for anyone interested in equitably scaling informal STEM learning programs and curricula, including, but not limited to, program developers, implementers, researchers, evaluators, and funders.

The document can be used by the following:

- **Implementers** as they work directly with youth and families and advocate for more equitable approaches to scaling partnerships
- **Program developers** as they engage in program planning and decision-making as programs are designed or revamped
- **Researchers and evaluators** as they work with implementers and program developers to study, test, and refine programs that scale
- **Funders** as they design funding strategies, requirements, and proposal expectations related to scaling programs

DEFINING EQUITY

For the purposes of this document, *equity* in informal STEM learning is the process of consistently reflecting on, evaluating, and disrupting broader systemic barriers and biases that implicitly and explicitly exclude people from participating in order to ensure that everyone has what they need to thrive.



What Is Scale?

Scale involves taking a curriculum or program that has shown positive impacts in one context (e.g., increased positive STEM identity, critical-thinking skills, career awareness) and spreading, replicating, or reproducing it in other informal learning contexts to reach more people and maximize impact (Dede & Rockman, 2007; Koch & Penuel, 2010). It is often seen as the next step in the life cycle of high-quality informal STEM learning programs, maximizing resources through replication and streamlining funding needed to sustain the program. This is evidenced by the vast number of scaled programs that started as localized models (Education Northwest, 2020).

The following are three example informal STEM scale scenarios:



THREE-WEEK ENGINEERING PROGRAM FOR MIDDLE SCHOOLERS

A university in a large urban center has developed a three-week engineering program for middle schoolers that they piloted in five afterschool programs in their city. The program's goal is to introduce youth to the engineering design process. Based on the evidence of the initial program's success, the university has received a three-year grant to scale the program to 100 afterschool programs nationally.



SUMMER STEM INTENSIVE FOR HIGH SCHOOL STUDENTS

A chemical company's community outreach department has developed a summer STEM intensive for high school students focused on mentorship and career development. They piloted it with a group of 15 students and now want to scale their reach across a five-state region to reach 1,000 students.



TRAVELING EXHIBIT ON THE BRAIN FOR LIBRARIES

A museum has developed a traveling exhibit on the brain designed for libraries. The exhibit includes hands-on interactives and informational displays to introduce the public to neuroscience concepts. Museum staff conducted an intense pilot study in three libraries while developing the exhibit. The museum has now received a federal grant to scale the exhibit to 15 libraries nationally.

CONTEXTUALIZING THE ISSUES

Over the last 20 years, museums, universities, and other STEM-focused institutions have engaged in significant efforts to partner with afterschool programs, libraries, and community organizations to develop STEM programming and increase the capacity of educators to provide impactful STEM learning opportunities for youth (Feder & Jolly, 2017; National Research Council, 2015).

Examples of National Scale-Related Programs and Informal STEM Initiatives

SCALED PROGRAMS Engineering is Elementary <i>Museum of Science, Boston</i> SciGirls <i>Twin Cities Public Television</i> Leap into Science <i>The Franklin Institute</i> Science Action Club <i>California Academy of Sciences</i> CryptoClub <i>University of Chicago</i>	NATIONAL ORGANIZATIONS Girls Inc. 4-H Girl Scouts of USA YMCA Boys & Girls Clubs of America Techbridge Girls
NATIONAL NETWORKS National Informal STEM Education Network <i>NISE Network</i> STAR Library Network <i>Space Science Institute</i> Citizen and Community Science Library Network <i>Arizona State University & SciStarter</i> NASA's Universe of Learning <i>NASA</i>	FEDERAL AGENCY PROGRAMS Afterschool Universe <i>NASA</i> 21st Century Community Learning Centers Watershed STEM Education Partnership Grants <i>NOAA and U.S. Department of Education</i> Maker/STEM Education Support for 21st Century Community Learning Centers <i>Institute of Museum and Library Services and U.S. Department of Education</i>

To address continued disparities in access, equity, and program quality, many informal STEM learning developers have intentionally scaled their locally designed initiatives to educators and youth across localities, regions, states, and countries to expand program reach and broaden participation for people historically marginalized and systemically excluded from STEM (James & Singer, 2016). For example, a 2020 Overdeck Foundation-funded landscape analysis revealed a wide range of scaled programs, including several afterschool STEM curriculum modules, summer camp models, and STEM career mentorship programs (Education Northwest, 2020).

However, decisions regarding which programs to scale, the process by which scaling occurs, and who is invited to plan have been questioned by local implementers.

These implementers include educators, technical support providers, and site directors from informal learning environments, such as libraries, afterschool programs, museums, and other community-based out-of-school time settings. Additionally, many practitioners have voiced concerns that the scaled initiatives they implement fall short of their expected outcomes (e.g., equitable youth

engagement in STEM, increased STEM learning, interest in STEM careers), while unintentionally reinforcing historical inequities, devaluing communities' expertise, and exacerbating power dynamics with the communities they are trying to reach. These concerns have led to calls for more equitable and inclusive practices when scaling.

Equity cannot be achieved solely by increasing access to turnkey informal STEM learning programs, even with compelling evidence of prior success.

Within the varied landscape of informal education, no two organizations, contexts, or local communities are alike. Therefore, when taking an informal STEM learning program or curriculum from its initial implementation context to scale, assumptions about the local outcomes of interest, culturally and contextually relevant activities, and available resources cannot be made (Penuel et al., 2014). Programs at scale involve a larger and more intricate network of people, such as program developers, evaluators, trainers, community organization staff, and educators, who implement the program to achieve the predetermined project outcomes and impacts—which are vital to a scaled program's success on the ground with youth and families. Dawson (2017) articulates that in addition to the need for providing broad access, essential to achieving equity is recognizing, respecting, and valuing that people differ and thereby taking their differences into account rather than treating everyone's needs as the same.

Limitations of Using Scaling Frameworks in Informal STEM Learning

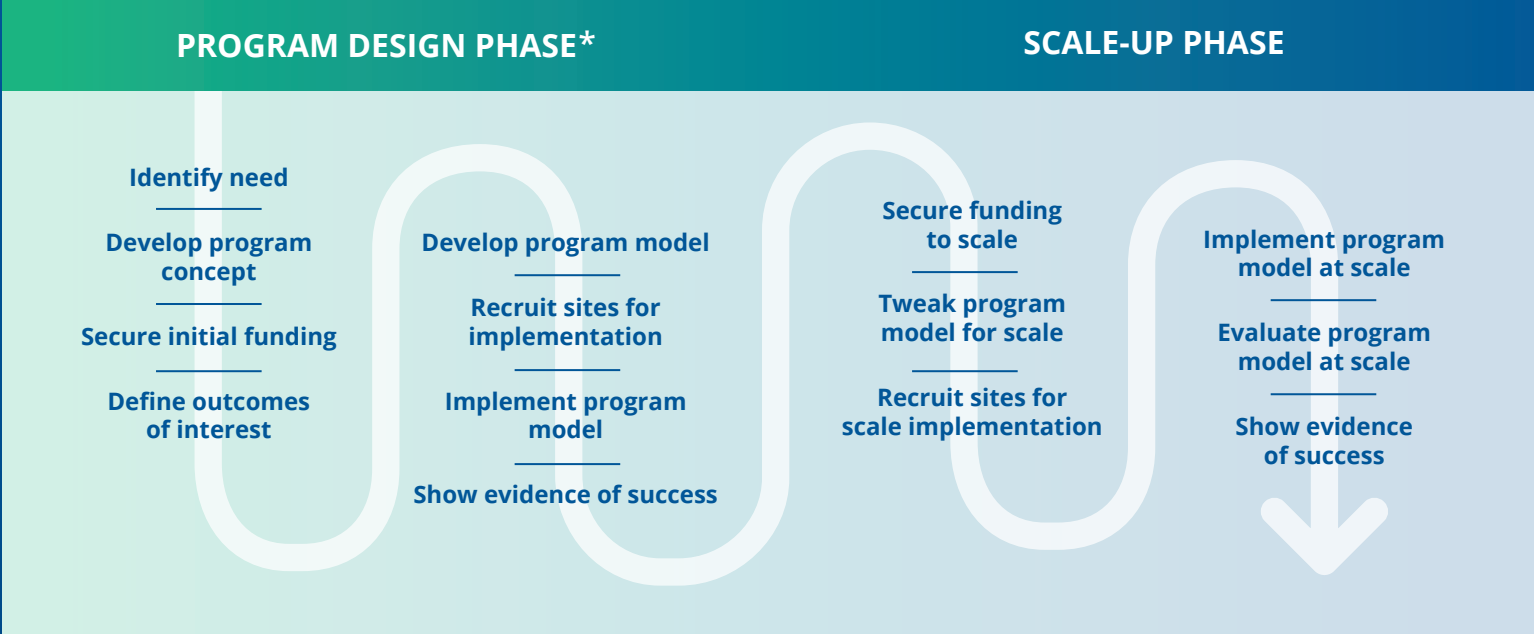
There is a notable lack of research on the unique opportunities and barriers in scaling across informal STEM learning settings. Much of the current research on scaling programs is rooted in formal K–12 educational reform. However, a breadth of research exists surrounding the dimensions of scaling education initiatives in formal education settings, offering a nuanced perspective on considerations for scale in informal settings (Morel et al., 2019).

For example, Cynthia Coburn (2003) offers a conceptualization of scale for K–12 education reforms that deconstructs the idea of scale into four dimensions: (1) the spread of an intervention to new contexts, (2) the depth of transformation of practice among those adopting it, (3) the shift in ownership from those who created the intervention to those who adopted it, and (4) program sustainability over time. This scale conceptualization has been applied to out-of-school time in general and, specifically, to informal STEM learning (Education Northwest, 2020, Penuel et.al, 2014). Yet, there are limitations to its utility, as the idea of scale is centered on education initiatives entrenched in formal education systems. Moreover, these frameworks often fail to critically investigate the inequities or power imbalances impacting how and with whom programs are scaled. An analysis of these frameworks and practices shows a limited focus on scaling with equity at the center of the process.

Lifting Up Voices throughout the Scaling Process

Over the last two decades, NGCP and EDC have supported and studied scale across numerous informal STEM learning programs, many operating from a similar developer-driven process model.

Typical Developer-Driven Design Process



*The program design phase may be iterative and refine the model before choosing to scale up.

Across scaled programs, the individuals and organizations closest to youth and families—community organization staff and educators—are commonly excluded from conversations regarding the implementation of scaled programs. Developer-based or funder-based assumptions during both the design and scale-up phases are often grounded in deficit-based models of thinking and a lack of communication with the people receiving the program, which can lead to pervasive challenges at scale.



Program Design Assumptions That Impact Equity

Even if collaboration is a priority during the design phase, assumptions still occur when programs scale, including:



Presumption of a local need or desire for the program



Objectivity of the STEM content



Available staff time across organizations



Organization's capacity to implement



Staff comfort with leading informal STEM learning

These assumptions lead to issues such as a lack of local staff buy-in, challenges with youth recruitment or attendance, struggles with sustainability beyond the life of the grant, and a lack of culturally relevant practices (Stafford et al., 2023).

Those receiving the program are often denied the ability to weigh in on whether to scale, how to define the outcomes, and how to determine a program model and activities that work in a local context. Instead, these components are commonly defined by program developers or their funders during the initial design phase, with limited discussions that include community partners about why to scale and who wants or needs the program.

With local community voices absent, informal STEM curricula and programs will likely lack cultural relevance. Additionally, identified outcomes may not be important to communities, and the selection of topics, materials, or activities may reinforce stereotypes about communities, exacerbate historical traumas, or unintentionally devalue community identities or ways of understanding the world.



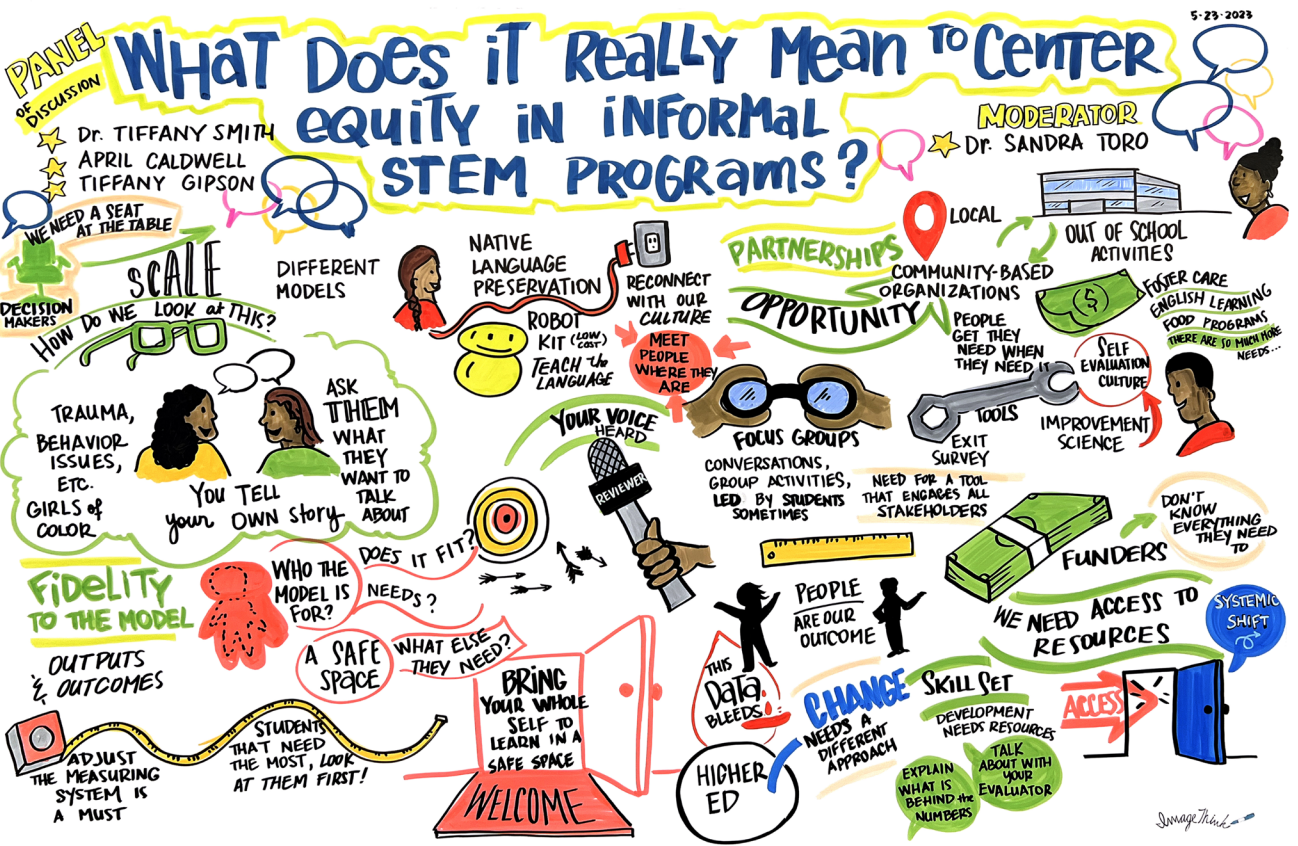
ADVANCING THE CONVERSATION CONFERENCE

The *Advancing the Conversation on Scaling National Informal STEM Programs* conference brought together informal STEM educators, out-of-school time site directors, and informal STEM program developers from museums, universities, and other STEM-focused institutions to collaboratively redefine principles for scale that center on equitable informal STEM learning from the perspective of those working directly with youth. Through collaborative discussions and activities across two days, participants explored current models for scaling informal STEM learning and imagined new approaches centered on equity and inclusion processes and practices.

VOICES FROM ACROSS THE FIELD

The project team strategically invited participants representing the diversity of informal STEM practitioners in job focus, career stage, geography, race, ethnicity, and gender. Significant effort was made to invite those who serve populations systematically excluded and historically marginalized in STEM, including girls, youth of color, Indigenous youth, youth with disabilities, and neurodivergent youth. Participants also included informal STEM learning and equity-focused researchers, evaluators, and program funders, including program officers from the National Science Foundation.

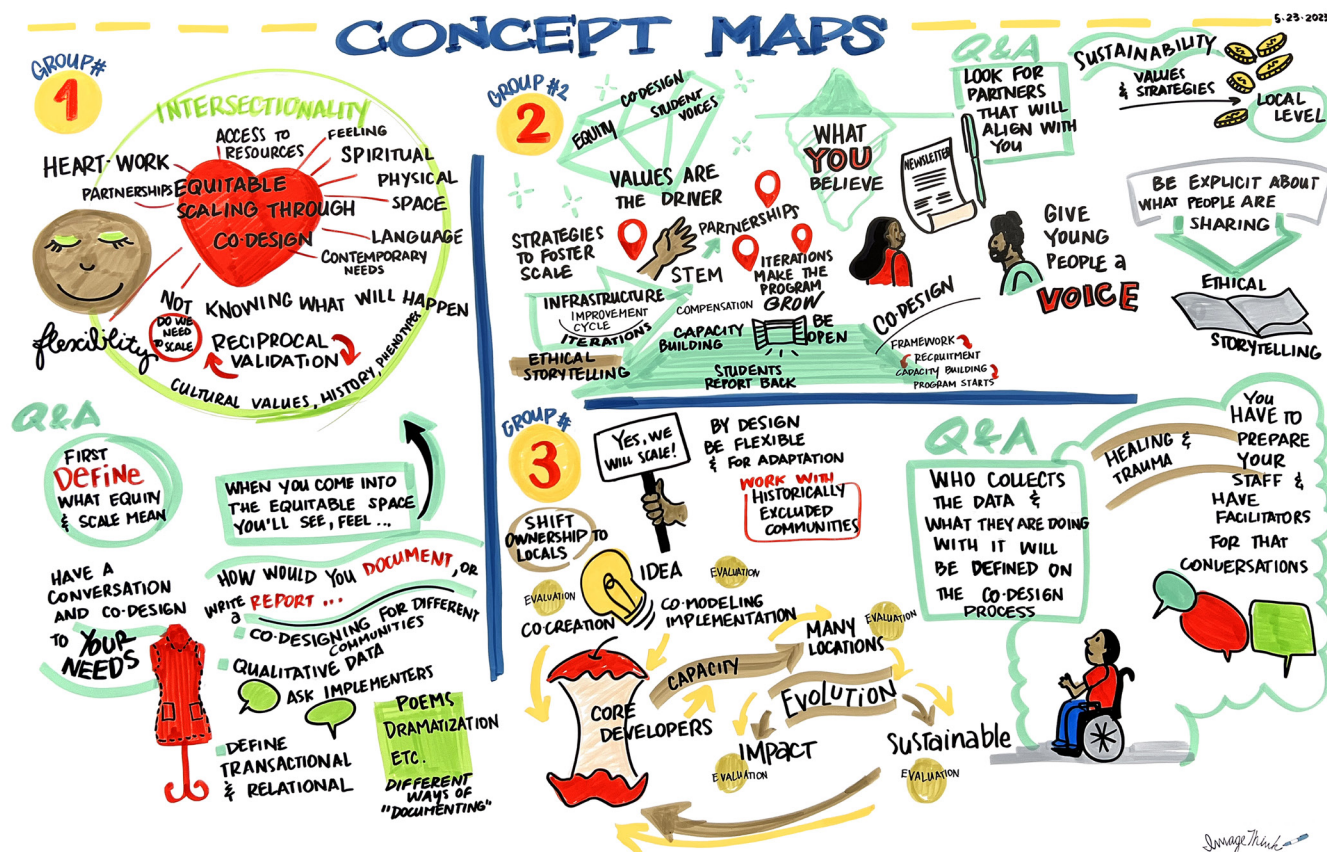




Conference Themes

Conference participants concluded that equitable and inclusive scale should go beyond expanding informal STEM learning programs or initiatives for the purpose of basic access to opportunities. Scale must prioritize culturally and contextually relevant programs that value community expertise, allow for flexibility and adaptation, and incorporate outcomes of interest to specific communities, thereby increasing opportunities for youth learning and engagement.

Concept Maps for Equitably Scaling Informal STEM Programs



Specifically, conference participants surfaced several common themes and core struggles calling for the reframing of equitable and inclusive scaling of informal STEM learning programs. These include the following:

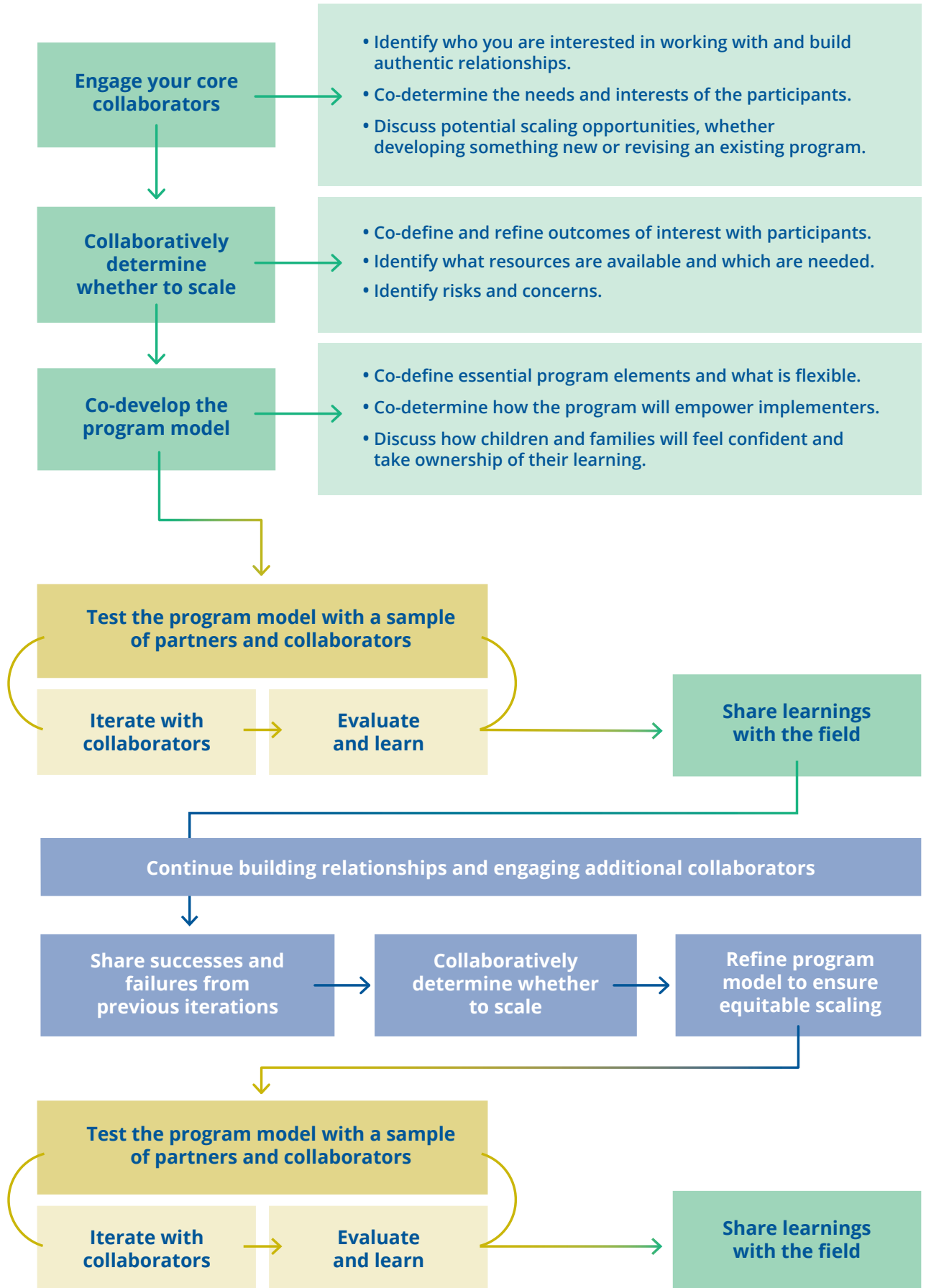
1. Equitably scaling informal STEM learning requires **establishing an equal balance of power** between those funding, developing, and researching the program and those implementing and participating in it. Scaling informal STEM programs **cannot be solely driven by the interests of the developers and funders**. A clear need and interest should be established by members of the communities who are being asked to participate. Program implementers should also have the opportunity to make decisions about scaling the initiative. If not, the initiative can become transactional, which could exacerbate racial, geographic, and cultural inequities.

- 2. Trust must be fostered with those in the communities** where the initiative aims to scale to establish **deeper and more authentic collaboration**. To establish trust, program developers should take time to understand the cultural norms, values, and historical inequities faced by the people with whom they hope to engage. Trust can be built by actively listening, including all parties in decision-making, and being accountable. It is crucial to show up authentically, lead with humility, and be open to new ideas when building trusting relationships.
- 3. Equitable scaling should prioritize flexibility and local culturally relevant adaptation** over strict fidelity to the program model. There is no one-size-fits-all program, and focusing on a strict model will likely not lead to achieving outcomes in all contexts. When scaling focuses on the exact replication of a program curriculum rather than building an adaptable model from the start, it can lead to culturally and contextually irrelevant and potentially insensitive or harmful content.
- 4. Practitioners identified a need to create new interventions to help people think differently about scaling.** To help meet this need, we offer a practitioner-driven model for scaling that centers the program implementers and their communities and the subsequent guidelines.



PRACTITIONER-DRIVEN DESIGN PROCESS

Engage funders, researchers, and evaluators in the process.



GUIDELINES FOR EQUITABLY SCALING INFORMAL STEM PROGRAMS

Drawing directly from the conference themes, the following six guidelines for equitably scaling informal STEM programs emerged:

- 1 Proactively build authentic relationships with the educators, youth, and families you aspire to reach.** Before deciding to scale an informal STEM program to a certain location or population, it is critical to build relationships with the people you hope to work with rather than relying on proxy representatives to speak on their behalf. Building authentic relationships takes time and intention. Provide a space to get to know each other and build trust, allow opportunities for dialogue and questions, and formally or informally gather data to guide the conversations.
- 2 Collaboratively determine whether to scale alongside these educators, youth, and families.** Challenge your assumptions about the needs, interests, and values of the communities you hope to reach through your informal STEM learning program. Bring all collaborators together to determine if the program is valuable and needed by the educators, youth, and families. Actively, compassionately, and empathetically listen to what they have to say. Be open to the idea that scaling might not be the best fit for every site or community.
- 3 Determine together what will be scaled, how, and with whom.** If you collectively decide to work together, spend time developing a program plan that centers on equitable practices, including those listed in guidelines 4–6 below. Those implementing and receiving the program should be meaningfully involved in the scaling process.
- 4 Redefine program success by co-defining or refining goals and outcomes.** The outcomes and goals you hope to achieve through scaling your informal STEM learning program may not be the same goals and outcomes that the people receiving the program, the funders, or the researchers hope to achieve. It is important to bring all collaborators together to co-define or refine what success looks like for your scaled program.
- 5 Prioritize flexibility over fidelity by collaboratively deciding what is essential to the program model and what can be adapted.** Develop a program skeleton that can be easily adapted and expanded upon to serve local community needs rather than creating a rigid curriculum or model. Enable informal STEM learning program implementers with the knowledge, skills, and confidence to make necessary adaptations through capacity building and technical support.
- 6 Empower participants through capacity building and iteration.** Provide room for iteration and support in the scaling process by purposefully allowing space for reflection. Be transparent about your own challenges and failures and allow space and support for others to share theirs. Knowledge building comes from reflecting on experience.

USING THE GUIDELINES

When considering if and how to scale an informal STEM learning program, practitioners can use the ***Collaborative Decision-Making Tool for Equitably Scaling Informal STEM Programs*** to engage in conversations about whether to scale and if so, how and with whom. The guidelines can also be used to re-envision an already existing program. Although there is no one way to apply these ideas, the decision-making tool provides a starting place for program developers, implementers, funders, researchers, and evaluators interested in employing these ideas in their practice.

UNANSWERED QUESTIONS

Keeping these guidelines in mind, NGCP, EDC, and the conference participants continue to wrestle with several core areas as they relate to equitable scaling in informal STEM learning, including the following:

Application and case study examples: During the *Advancing the Conversation on Scaling National Informal STEM Programs* conference and subsequent product co-development efforts, practitioners identified the need to examine how practitioners implement these guidelines and the decision-making tool in real-world settings. These case study examples could lead to refining the guidelines and the decision-making tool based on scaled informal STEM learning programs that center equitable practices and processes.

Network of practitioners: Practitioners expressed interest in being part of an established network of informal STEM learning practitioners, including implementers, developers, funders, researchers, and evaluators, who are invested in more equitable scaling of informal STEM learning programs. This network would give practitioners a safe space to share the successes and challenges they experience while wrestling with what it means to scale more equitably and inclusively.

Why scale?: Some practitioners disagreed on whether it is possible to equitably scale informal STEM learning programs because of the complexities and limitations of a national program model. This unresolved debate continues to serve as a reflection point in this ongoing work.

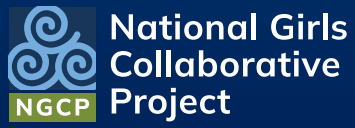
FUTURE EFFORTS

This paper and the included guidelines are the beginning of a conversation and thinking about scaling informal STEM learning that prioritizes equity. As cited earlier, equity in informal STEM learning is a process and contextually dependent on the people and communities engaging in this type of learning. This work will look different for everyone.

We encourage you to discuss these ideas with your colleagues, peers, and partners to see what surfaces. In an ongoing effort to advance the conversation, we welcome your thoughts, reflections, and questions. Please reach out to us at the [National Girls Collaborative Project](#).

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