

ENHANCING PROFESSIONAL LEARNING CAPACITY FOR INFORMAL EDUCATORS

FINAL REPORT

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INTRODUCTION

This cohort's efforts have been focused on enhancing the professional capacity of informal educators, with a particular emphasis on equity, inclusion, and well-being in STEAM. Our discussions have focused on three key questions:

- Whose professional capacity are we enhancing and for what purpose?
 - How do we prioritize diversity, equity, and inclusion?
 - What skills and practices are crucial for identity and well-being in STEAM?
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KEY FINDINGS AND PRIORITIES FOR FUTURE WORK

A summary of themes that emerged from our discussions and background research are as follows:

1. **Professional Learning for Whom?:** Key questions have emerged around *whose* professional capacity to address and for what purpose. There was wide agreement that to address issues of equity and inclusion in STEAM, we need to cast a wider net in identifying who we are attempting to reach and how to reach them, given that many who are actively engaged in supporting STEAM education don't self-identify as STEAM educators. Defining professional learning capacity of informal educators has to take into account the diversity of organizations that provide STEAM experiences and the different roles that exist within these organizations at early, middle and mature career levels. Developing professional

learning competencies in the informal field also depends upon individual, institutional, and social contexts and needs. The goal of our work should lean into building identity, well-being, and belonging into these varied educational roles and settings .

2. **Defining Capacity & Purpose:** The cohort spent a lot of time on trying to refine the focus of the cohort, especially in defining what "professional capacity" entails in informal science education given the diversity of organizations and institutions that support STEAM learning and the different needs of individuals at different stages of their careers. A number of frameworks were explored (Bevan et al., 2010, Heimlich et al, 2021; & ASTC's professional learning framework: <https://www.astc.org/isl-framework/>). Among the competencies considered were both on the individual and institutional levels, including professional learning focused on increasing knowledge of STEAM content and informal learning practices, engagement strategies for helping visitors and audiences, strategic practices to promote equity and inclusion (e.g. reflective practice) and critical use of technology.
3. **Educator Roles & Career Trajectories:** Discussions centered on the different career pathways for informal educators, noting the need to support educators in viewing these roles as sustainable, long-term careers rather than temporary jobs. Understanding factors that lead to career growth within STEAM is an area for future inquiry.
4. **Diversity, Equity, and Inclusion (DEI):** Prioritizing DEI in professional development has been a focal point, with the group considering how these values can be embedded in capacity-building efforts. We explored how to support educators who represent diverse backgrounds and experiences at early, mid, and mature career levels, ensuring that growth opportunities are inclusive and accessible at each of these phases. Particular attention was paid to early and mid-career jobs in informal settings as these are often individuals who don't have access to professional learning opportunities but can benefit from them the most.
5. **Essential Skills and Practices for Professional Learning in STEAM:** There is an ongoing effort to define the essential skills and practices that contribute to the professional identity and well-being of informal educators in STEAM. This includes both technical competencies and soft skills like reflective practice, which are supported by resources and programs such as the *Reflecting on Practice* program.

6. **Research Partnerships & Career Development:** Discussions highlighted the value of research partnerships for professional learning, with contributors like Peter Wardrip focusing on building educator capacity in museums and Ren Mendoza exploring career trajectories for youth and non-formal educators. These conversations underscored the importance of connecting research and practice to understand trends in the field and to identify opportunities for growth.
7. **Need for Broader Challenges & Needs Assessments:** A recurring theme that came up is the challenge of providing professional development in informal settings, especially in the face of funding constraints. The cohort emphasized the importance of conducting a needs assessment survey to identify gaps in professional development for informal educators to get a more realistic picture of the landscape. This survey would help inform capacity-building efforts by not only assessing skill gaps but also by providing a better picture of what a sense of belonging, quality work, and identity looks like across various STEAM educational roles in a range of informal settings engaged in STEAM education.

Survey. As a precursor to doing a broader survey, the cohort decided to conduct a brief survey targeting members of all the cohorts to gather preliminary information. To get at many of the themes that emerged through our discussions, this brief survey addressed the following key questions:

- a. In your ISL work, which workers leading STEAM activities should identify as informal STEAM educators but currently do not?
- b. What type of training would enhance their sense of identity, confidence, and belonging in informal STEAM education?
- c. Who in your organization engages youth in STEAM programming, and what backgrounds or resources do they draw on? Who receives training, and who does not?
- d. Is there STEAM learning happening that is not currently labeled as STEAM ?

Overall, there were a whole host of non-traditional positions identified through the survey at all career levels who are involved in supporting STEAM learning in different organizations (see PowerPoint for examples). Existing training and professional learning experiences for these different roles were varied and included: opportunities for building connections with others and networking through professional conferences, conducting presentations with more experienced colleagues, the sharing of case studies by experienced educators, virtual modules from different informal educational settings that showcase the

range of contexts and approaches in STEAM education, and opportunities for receiving awards and recognition for inclusive work in STEAM.

Key issues in increasing professional learning capacity to promote equity and well-being in STEAM include: experiences that embrace an integrative approach to STEAM education that break down content silos in organizations and focus on authentic multidisciplinary and transdisciplinary approaches to STEAM; engaging educators as learners themselves; role modeling what good STEAM education looks like where the “A” isn’t an afterthought; and highlighting how professionals’ own STEAM experiences are relevant to being a good STEAM educator. Respondents suggested resources for training early, middle, and more mature career level practitioners, including STEAM kits from Amazon, cultural resources that integrate the arts into STEM from different cultures, building on prior education and field experiences of staff, and more formalized resources from NAAEE (North American Assn. for Environmental Education) and other professional associations that are integrating STEAM into their work.

8. **The Value of Professional Learning Frameworks:** Priya Mohabir introduced a valuable framework for capacity building, which the team agreed to use as a foundation for their initiatives. The group also explored resources like the ISL Framework and Trish Patrick’s work on professional competencies, emphasizing reflective practice as a cornerstone for growth in informal science education settings (see references below and in the [PowerPoint](#)).
9. **Professionalization & Certification:** The idea of formalizing professional development through formal certification programs was debated, with some recognizing the benefits of professionalization. However, most recognized how this would not be the best fit for the multidisciplinary, decentralized, and non-traditional nature of the informal education field that is often shaped by their own institutional missions.

CASE STUDIES

Professional learning programs that simultaneously address STEAM learning, informal educators, and issues of equity, well-being, and inclusion have been largely limited. This gap is often due to the absence of formalized programs tailored to early and mid-career informal STEAM educators coupled with the high turnover rates common in informal learning organizations that might support STEAM education. To address these

gaps, our cohort identified both formal and informal initiatives that might provide valuable insights into strategies for enhancing professional learning capacity of informal educators that could be applied to support inclusive STEAM informal learning.

Kennedy Center for the Arts: Arts Integration: Science Professional Learning Resources

This particular use case is of a set of professional development resources and experiences for formal educators that explores strong arts integration connections between story dramatization, choreography and science. This particular program was developed for formal educators, but one cohort member participated as an informal partner in this program and saw the strong potential for it to increase the professional learning capacity of informal educators working on integrating the arts into their STEM practices. Their [philosophy behind arts integration](#) is thoughtful and grounded in many of the principles discussed at our NSF grant conference for transdisciplinary learning. Unfortunately, they were unable to gather more information when reaching out to the Kennedy Center. The website provides more detail on their approach.

ACRES (Afterschool Coaching for Reflective Educators in STEM)

ACRES is a nationally acclaimed virtual training program created in 2016 by the [Maine Mathematics and Science Alliance](#) as a way to provide high quality STEM facilitation training for rural out-of-school educators, particularly afterschool educators. One of the greatest barriers to equitable professional learning opportunities for rural educators is the challenge of gathering in person for training events, especially multi-part training events. Rural educators also struggled with a sense of isolation and lack of community with others running similar programs. ACRES, originally called Afterschool Coaching for Rural Educators in STEM, is centered on building safe and brave virtual spaces to practice the action-reflection cycle centered around inquiry-based STEM learning and elevating youth voices. While ACRES' primary focus is STEM, some of the out-of-school educators and education programs they train have a broader STEAM focus.

Since being created in Maine, the program has expanded to train teams of coaches in other states (New York, Missouri and Illinois) with geographically spread out populations. Its virtual format was also popular during the COVID-19 pandemic when educators were restricted from gathering in person. As of 2024, educators from all 50 states have participated in the program. The traditional ACRES model creates an online professional learning community with cohorts of 3 to 12 educators working with a coach via Zoom. Most trainings are designed as 3-part modules. Topics include "Asking Purposeful Questions" (a prerequisite for all other modules), "Facilitating Engineering

Practices”, “Nurturing STEM Identity and Making Career Connections” and “Making Math Engaging”. Modules are designed to support differentiation throughout the training process and can be used in person or in a hybrid manner.

ACRES supports rural educators who are not able to travel for multi-part workshops. The training follows an action-reflection model. A facilitation skill is introduced in the first session. Participants watch videos of educators using that skill and participate in a hands-on activity using easy-to-find supplies with their coach modeling the facilitation skill. Between the first and second session, the educators are instructed to practice the facilitation skill with youth in their program. Ideally, they record themselves doing this in a 2-5 minute video.

During the second session, participants take turns sharing their video and practice the skill of giving and receiving feedback. Additional real-life videos of educators using the skill with youth are shown and critiqued as a group. Between sessions two and three, educators have a second opportunity to practice the facilitation skill, record themselves, and receive a second round of feedback from their cohort.

While most participants have access to a camera on their phone, they often struggle with either finding the time to make the recordings, concerns with privacy issues (videos are deleted immediately after being shown during the feedback process), and/or discomfort seeing themselves on camera. Retention over the course of a 3-part training is also difficult as out-of-school educators are often overwhelmed, working in programs that are understaffed.

However, analysis of feedback from participants in ACRES, both the coaches and educators, has shown that the focus on intimate communities built around genuine engagement with one another has had a profound impact. While the program is focused on STEM skills and youth empowerment, participants have successfully translated these skills to other areas of their work with youth including STEAM programming. MMSA (Maine Mathematics and Science Alliance) has published many papers about ACRES and links to these can currently be found on their [ACRES website](#). They are in the process of creating a new website which will go live in 2025. If the above link does not work, the new website will be linked to from the [Maine Mathematics and Science Alliance](#) page.

[Critical Relationality Alliance for Transformation \(CRAFT\) Network](#).
aka The **[Investigating STEM Literacies in Makerspaces](#)** Project

The CRAFT Network is an NSF-funded Research Coordination Network that was

initiated in 2016 and charged to study, support, and document people's use of representations in different kinds of makerspaces. The project has defined and illustrated 5 key STEM "literacies"- identifying, organizing, and integrating information; creating and traversing representations; communicating with others for help and feedback during making; documenting processes; and communicating finished products.

The network's research findings to date are:

- Making encourages vitality and transformation *through multiple ways of participating and belonging*;
- Making is a human experience that is essential in our lives, families, cultures, and manifested in our goals, hopes and dreams;
- Making artifacts represent a community's shared humanity and create opportunities for dialogue.

CRAFT has compiled [a list of scholarly resources](#) and, drawing on these, relevant theoretical frameworks, and through rigorous testing the RCN is now applying what they are learning to *their work with practitioners* across the network. Organizations, projects and programs wishing to join the network may [apply free of charge](#) to receive information about events, tools, and *professional learning opportunities*. More information about the project, including links to videos, project products, and publications can be found on their InformalScience.org project page [here](#).

NYSCI: Designing with Agency and Facilitating with Empathy

Drawn from the following articles:

Letourneau, S. M., Bennett, D., McMillan Culp, K., Mohabir, P., Schloss, D., Liu, C. J., & Honey, M. (2021). A shift in authority: Applying transformational and distributed leadership models to create inclusive informal STEM learning environments. *Curator: The Museum Journal*, 64(2), 363-382. Link [here](#).

Liu, C. J., Mohabir, P., & Bennett, D. (2023). Inclusion Is More Than an Invitation: Shifting Science Communication in a Science Museum. In *Race and Sociocultural Inclusion in Science Communication* (pp. 19-34). Bristol University Press. [Link to manuscript here](#).

NYSCI (New York Hall of Science) has a unique and longstanding youth development program that has been the corner-stone of the museum for the past 30 years and has been replicated nationwide by other science centers and institutions. It prepares youth

to act as docents or facilitators of the museum's programs and exhibits, through a variety of activities including direct engagement with visitors on the museum floor. High school and college students, known as Explainers, are recruited from the museum's local neighborhoods to facilitate public programs and engage with visitors around the content and substance of museum exhibits. For years, Explainers have participated in ongoing professional development, learning opportunities, and mentorship with museum professionals to help them develop communication skills and STEM knowledge, with the end goal of supporting visitors in grasping the science content behind NYSCI's interactive exhibits and programs.

As the institution began to integrate more visitor-centered design and making experiences onto the museum floor, they recognized the need to shift explainer training away from focusing on communicating scientific information and ideas and toward following visitors' leads, encouraging their curiosity and questions, and supporting them in pursuing their own distinctive approaches to problems. Well-established facilitation techniques that had previously been used by Explainers to help visitors arrive at formal explanations for scientific phenomena would no longer be enough. Now, Explainers needed to be prepared to take on new roles as guides, discerning visitors' interests and nurturing visitor agency in tackling STEM-based challenges and questions. At the same time, the need to transform facilitation practices was not entirely obvious to many of the museum's experienced Explainers or even to the training team at the start.

To address these challenges, the staff leading the explainer training program had to identify new indicators of success that Explainers could use to guide their interactions with visitors and that would call attention to different dimensions of STEM learning that integrated the arts and making. Two parallel programs were instrumental in making this possible — a privately funded effort designed to empower our youth to be part of our institution's transformation, and a research program funded by the National Science Foundation that focused on supporting floor staff in reframing engineering practices in more equitable ways in their work with visitors. In both projects, project leaders worked with Explainers to transform their interactions with visitors by creating a culture of experimentation, ownership, and reflection, in which Explainers' perspectives and ideas were integral to the development of new facilitation approaches and museum experiences.

A first step in shifting Explainers' interactions with visitors was developing a shared language to describe what positive visitor engagement might look like. Rather than continuing down the typical path in which staff responsible for training floor staff would tackle this challenge on their own, the project leaders pulled together a cross-departmental team that represented diverse perspectives. The team members included

the Explainers and Explainer trainers, education researchers, program developers, and exhibit designers. Each participant offered unique perspectives and areas of expertise: Exhibit designers had a deep understanding of the intention behind museum exhibits and activities, and program operations staff shed light on the disconnects between the intent of our designs and pragmatic operational concerns. Youth program staff articulated the core needs and practices that came into play in youth development. Explainers offered their first-hand experiences engaging visitors, and researchers provided expertise in the area of progressive child-centered approaches to STEAM teaching and learning as a lens for reflecting on visitor interactions and Explainers' roles in that process. These multiple perspectives were critical to enriching the work of our youth development team and, more importantly, to laying a foundation for more widespread institutional change and training materials.

Through this collaborative work, NYSCI identified a set of Explainer habits of mind (including curiosity, flexibility, empathy, persistence) to guide how Explainers themselves would relate to and engage visitors in STEAM experiences in Design Lab, a design and engineering space where arts and making were integrated into hands-on design experiences but not the end goal. These habits of mind were intended to help explainers respond nimbly to visitors' diverse backgrounds, experiences and interests in the context of problems that visitors would be invited to solve through hands-on design projects. Explainers were supported in putting habits of mind into practice by focusing on designing activities that encourage agency, creating pathways for personal choice for both Explainers and visitors in solving problems, facilitating with empathy, listening to visitors and following their lead, integrating personal experiences with STEAM and breaking down barriers for entering the activity/space.

Other relevant insights that grew out of our iterative work with Explainers that has direct relevance to STEAM-related professional learning is NYSCI's NSF-funded Narrative Elements Shaping Engineering Engagement project, an NSF-funded design-based research project with three museums which produced a guide for informal educators to integrate narrative elements into engineering activities to support storytelling, creative expression, and prolonged engagement in engineering practices. Educators who participated in conducting this work in their own museums spoke of the value arts and storytelling in increasing the capacity of informal educators to deepen visitors' engagement in engineering and problem solving. This work culminated in a practitioner guide for informal educators which provided concrete examples of the difference integrating narrative and empathy into design and engineering activities can make for visitor engagement. Resources like this are an example of resources that might provide insights for informal educators interested in how to put research into practice in their own settings.

Lawrence Hall of Science: Reflecting on Practice

First initiated in 2010 at the Lawrence Hall of Science in Berkeley, CA, this [professional learning program](#) is designed for practitioners working in informal STEM learning (ISL) organizations of all types and sizes, to build understanding of, experiences with, and integration of best practices in STEM. The program applies knowledge from learning and communication research and has created a community of practice among the ISL institutions who are using it.

The Reflecting on Practice (ROP) program has created four learning modules entitled *Learning, Reflections and Science*, *How People Learn*, *Learning Conversations*, and *Objects and Design*, and has produced a curriculum in the form of a book- [Reflecting on Practice for STEM Educators](#). ROP has found that its key areas of impact include:

1. Anchoring practice in reflection & learning, for both individuals & institutions
2. Offering language & routines for negotiating meaning
3. Advancing the field through recognition & credibility

Since its inception, ROP has offered 47 in-person, 3 blended, and 6 online workshops with more than 1000 educators from over 450 institutions across 36 states and 3 countries. The types of institutions, organizations and audiences served include zoos, museums, aquariums, national parks, youth organizations, libraries, NGOs, government agencies, classroom educators, evaluators, and consultants.

Independent external evaluation results found that participants reported:

1. Strong impact on encouraging them to be more reflective (paying attention to their own teaching, reflecting on what practices were working well).
2. ROP expanded their understanding of ways to engage learners online by introducing them to platforms and tools they could use to support that engagement
3. ROP helped them see the value and possibilities of online engagement and increased their confidence in their own abilities as educators.

More information on ROP, including a video with testimonials from program participants can be found on the [project's website](#) as well as on their InformalScience.org [project page](#).

A Professional Learning Community Advancing Informal STEM Learning for Black Girls

Drawing on insights gained from [Jasmine Johnson's dissertation](#) that utilized participatory action research, this study further highlights lessons learned about how to engage informal educators and educational leaders in dialogue about research-based solutions to support Black girls in STEM, and how a PLC might be designed to complement their efforts. Four examples of informal STEM programs for Black girls that are featured in the PLC's design are: COMPUGIRLS (Scott & White, 2013), I AM STEM (King & Pringle, 2018), Girls STEM Institute (Morton & Smit-Mutegi, 2022), and Digital Youth Divas (Pinkard et al., 2020). Based on the findings, this dissertation proposes a framework for Professional Learning Communities advancing informal STEM learning for Black girls. The PLC Design facilitated a cycle of brainstorming big ideas, identifying promising practices, and piloting quick wins that can advance informal STEM Learning for Black girls.

KEY REFERENCES (workbook [here](#))

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