Teachers participating in the Bakken Teacher Academy consider how to use history of science primary sources in their classrooms. Photo courtesy the Bakken Museum

Partnering With Education

By Beth Murphy

For most of my career in science and STEM education, I've worked at the interface between museums or other educational institutions and schools, finding synergies in their efforts to improve science learning experiences for kids and their teachers. When organizations work together, they can build on each other's strengths, share resources, overcome obstacles, and fill gaps. Truly, the whole is better than the sum of its parts.

What collaboration looks like can be simple—two individuals from two different organizations (for example, a museum and a school) working together to design, deliver, or improve a program. It can also be complicated, such as when multiple organizations come together to address a community-wide problem or work toward a systemic goal.

I've found the principles of Collective Impact (Kania & Kramer, 2011)—a research-based framework designed to address complex and specific social problems—to be useful in executing a wide range of collaborative work, though not all of the principles are applicable nor relevant to simpler or smaller-scale efforts. However, I've found some of the principles to be useful guideposts for every collaboration I've been part of.

Let's consider two examples of collaboration through the lens of Collective Impact: Bakken Teacher Academy: Science Learning from the Works of Scientists, a teacher program co-designed and co-facilitated by a museum educator and middle school teacher (Murphy et al., 2017), and STEM Pathways, a more complex collaboration between five nonprofit organizations and a school district (Walvig et al., 2016).

COLLECTIVE IMPACT CONDITION 1: COMMON AGENDA

All participants have a shared vision for change that includes a common understanding of the problem and a joint approach to solving it through agreed-upon actions.

Teacher Academy: In 2010, Minnesota adopted the Common Core State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects. These standards mean that Minnesota's middle and high school science teachers are now expected to teach their

students to read and write like scientists. At the time, I was working at the Bakken Museum in Minneapolis, an innovation-focused museum with a world-class collection of scientific and historical books and other texts, including many early works from the history of science. The science department at the local public school district realized it needed to do something to prepare its teachers to address these standards, and it was interested in using primary sources—writings from real scientists. The museum, with its library collection, history of science experts, and educators used to incorporating historical experiments and stories into their programs, was eager to engage more students and teachers with the history of science in meaningful ways. Thus, a synergistic partnership was formed to create a professional development (PD) program about science-specific instructional practices for teaching reading and to provide examples of primary source materials for the science classroom. As a result, a museum educator (me) and an experienced middle school science teacher worked together to develop and facilitate this new PD program.

STEM Pathways: In 2012, Wilder Research completed a follow-up study for STARBASE Minnesota—a Twin Cities informal STEM education provider—to learn about the long-term effects of its program on student participants, and suggest opportunities to further increase this impact (Mohr and Mueller, 2012). These findings led STARBASE Minnesota to connect with other organizations serving the same population of students with field trips and in-school programs. As a result, the Bakken Museum, the Bell Museum (Minnesota's state natural history museum), the Minnesota Zoo, and the Works Museum joined STARBASE Minnesota to establish a three-year collaboration to develop and test a connected pathway of STEM experiences for fourth and fifth graders at six schools in the same district. This collaborative effort was also of interest

Clockwise from top left: Fifth graders learn about components of an ecosystem and predict the impact of change at the Minnesota Zoo. Fourth and fifth graders learn relevant science content and use engineering and math skills to plan a mission to Mars. At the Bell Museum, fifth graders investigate the relationship between pollinators and food, and learn about the work of bee researchers. Fourth graders at the Bakken Museum reinvent the battery and design windmills to generate electricity. At the Works Museum, fourth graders use the engineering process to design their own game to take home. Photos courtesy Minnesota Zoo, STARBASE Minnesota, Bell Museum, the Bakken Museum, and the Works Museum, respectively

Secondary science teachers practice instructional strategies for teaching students to read like scientists using primary sources. Photo courtesy the Bakken Museum

to the district's STEM specialists, who were eager to work with community partners as a unit, as opposed to individually, to better support and accelerate the district's STEM learning goals.

Via an iterative process, partners arrived at the following description: STEM Pathways is a collaboration designed to raise access, enthusiasm, and academic achievement of young people in STEM and their preparation for future STEM careers. It aims to provide a deliberate, cohesive, and connected pathway of meaningful learning experiences and contribute to the Twin Cities' STEM learning ecosystem. The purpose of the STEM Pathways partnership is to develop, implement, and test a program model for achieving these goals.

COLLECTIVE IMPACT CONDITION 2: SHARED MEASUREMENT

Collecting data and measuring results consistently across all participants ensures efforts remain aligned and participants hold each other accountable.

STEM Pathways: Partners worked together to identify the following common goals: improving students' interest in and learning of STEM, building their STEM identities, and increasing their awareness of and interest in STEM-related careers. Working with the school district as a unit—and with an outside evaluation firm—STEM Pathways partners were able to conduct program evaluation together to determine how well outcomes were achieved that would not have been feasible independently. The effort dedicated to arriving at shared goals ensured that outcomes were important to all partners. Everyone was invested in the process of measuring the impact of their combined work and resulting findings—even though evaluation focused on the collective effort and not on individual programs. Because the outcomes were important to all partners, all were all invested in the process and its findings, even though evaluation focused on the collaborative effort and not individual programs.

Inspiring greater awareness and interest in STEM careers and improving attitudes toward STEM were priorities for STEM Pathways from the beginning. What was not known at that time, though, was how important these outcomes would be for teachers, schools, and the district. During project implementation, it became clear that teachers were quite interested in helping their students explore STEM careers but that they felt poorly equipped to do so. Thus, incorporating information on STEM careers into programming emerged as a way that STEM Pathways could contribute something that schools wanted and STEM Pathways could easily do. Mid-project pre-post surveys identified that students were not reporting the positive change in their confidence to do science that partners were anticipating. This led us to a more nuanced focus on STEM confidence—rather than a broad focus on STEM identity. To understand student survey responses, We conducted small group interviews with students to better understand their perspectives. This process of defining common goals and engaging in shared evaluation allowed partners to identify where to focus and then make programmatic adjustments based on evidence. A survey conducted one year after the collaboration had ended demonstrated that the focus on STEM careers and STEM confidence had influenced all partners in meaningful ways.

COLLECTIVE IMPACT CONDITION 3: MUTUALLY REINFORCING ACTIVITIES

Participant activities must be differentiated while still being coordinated through a mutually reinforcing plan of action.

Teacher Academy: Like many informal science educators, I am not a licensed teacher and I have never

worked at a school. Having a partner with years of experience teaching middle school science, who understands firsthand what it's like to be a teacher, and who was recognized by her district as a teacher-leader brought a lot of credibility. This complemented what I could bring: college-level teaching experience, experience working with adult learners, content knowledge in physics and history of science, and experience as a practicing scientist—as well as grant-writing and program-evaluation experience. We capitalized on each other's strengths and compensated for individual gaps, in a way that allowed us to create and deliver a PD program that was high quality, challenging, relevant, and authentic.

STEM Pathways: Partner organizations began to see themselves as working together to achieve a shared goal as opposed to competitors for the same audience. They recognized each other's unique contributions and how by working together they could amplify learning, make connections for students, and bring greater value to schools. Further, each organization brought specialized pedagogical and content expertise that allowed educators from partner organizations and the district to learn from each other. Informal educators learned that teachers particularly valued the out-of-school connections they could bring to students; they also learned how to enhance their programs' connections to school science curriculum and standards in deeper ways.

COLLECTIVE IMPACT CONDITION 4: CONTINUOUS COMMUNICATION

Consistent and open communication is needed among the many players to build trust, assure mutual objectives, and create common motivation.

Teacher Academy: Co-developing a teacher program required ongoing communication for clarity and division of labor for efficiency. My co-facilitator and I worked closely to develop workshop agendas and presentation materials, make decisions, and assign tasks to each other based on interest, expertise, and available time.

STEM Pathways: Involving leaders and educators from each informal science institution as well as the school district, it was essential to establish a communication system that was efficient and effective. We used an online project-management tool with different teams assigned to different projects, providing a system for coordinated messaging and sharing materials between individuals working on subprojects.

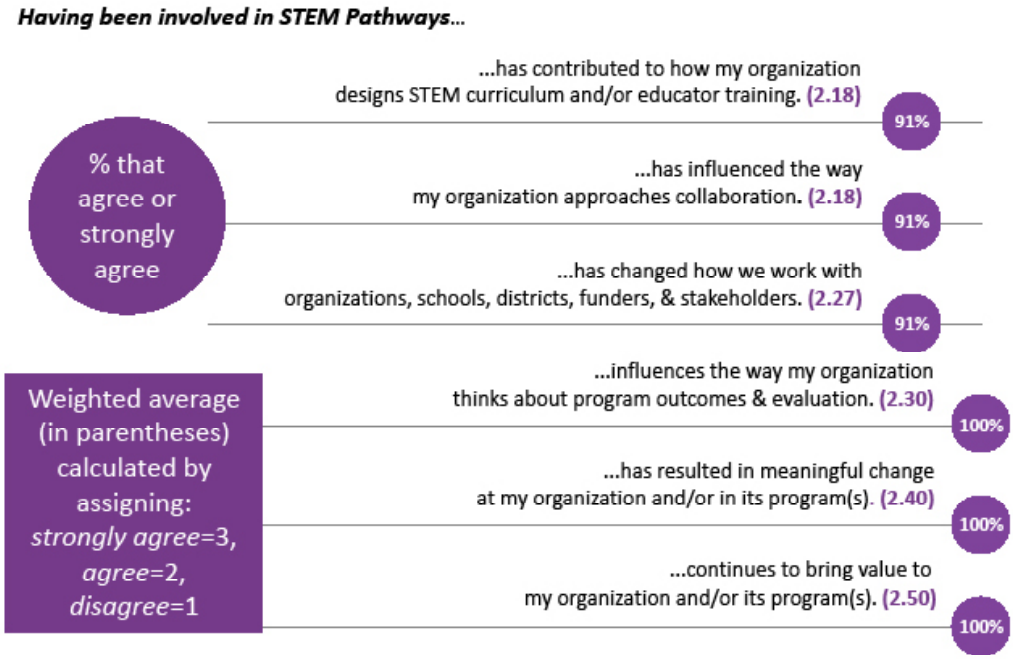
Regular in-person meetings—for leaders, for educators, or for everyone—were held for a variety of purposes: high-level consensus building and planning, shared learning and capacity building, analyzing program evaluation findings, and determining future actions in light of these findings.

COLLECTIVE IMPACT CONDITION 5: BACKBONE SUPPORT

Creating and managing Collective Impact requires a separate organization with staff and a specific set of skills to serve as the backbone for the entire initiative and to coordinate participating organizations and agencies.

STEM Pathways: Although STEM Pathways did not include an external backbone organization, it did approximate it with an independent project director

A museum educator and experienced teacher complement each others' strengths and experiences in the Bakken Teacher Academy. Photo courtesy the Bakken Museum



Survey respondents (four leaders and seven educators from partner organizations) indicated the degree to which they agreed with the statements above.

hired on behalf of the collective. Unlike authentic Collective Impact initiatives, this model required budget and grant management and reporting to stakeholders to be the responsibility of a partner rather than external organization. Such arrangements do run the risk of perceived or actual imbalances in control, power, or accountability between organizations, which is another reason why effective communication is so important.

CLOSING THOUGHTS

Teacher Academy: There is no doubt in my mind that Science Learning from the Works of Scientists was a higher quality and more impactful PD program because of the level of involvement of both a museum educator and K-12 teacher in design, development and implementation.

STEM Pathways: In a survey conducted a year after the collaboration ended to understand lasting impact at the programmatic and organizational levels, participating leaders and educators reported that participation in STEM Pathways resulted in meaningful change at their organizations that continued to influence how they work with other organizations and design programs, how they think about STEM identity and career awareness, and how they implement program evaluation. Self-reported change is shown in the figure above.

Unfortunately, despite the will to do so, the STEM Pathways project did not continue beyond the three-year duration of the pilot. Collaboration at this level is hard: It takes resources such as time, staff, and funding—this is in addition to an organization's regular operations and thus cannot be accomplished simply by reallocating resources. Successful, ongoing collaboration requires a paradigm shift in thinking on the part of individual organizations and their funders and stakeholders.

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