Beyond the Webinar

Dynamic Online STEM Professional Development

Alexandria Brasili and Sue Allen

A group of six afterschool educators come together for a monthly professional development course in which they are learning to facilitate STEM programs effectively. Today's meeting focuses on how to model science practices. To begin the meeting, the facilitator sets up an icebreaker to allow the other five educators to get to know one another better. *The facilitator asks, "What upcoming STEM program are you most excited about?" Sofia, an afterschool educator at a 4-H program, talks about the summer coding club that she is starting; the other participants join in.*

As the session gets going, the educators talk about their visions for science education in their afterschool programs. Then they watch and discuss a video of youth carrying out an investigation with eggs and seeds. The group discusses why it is important for youth to investigate their own questions. Sofia shares, "My kids are so much more invested in their learning when they are investigating something they care about. When they come up with the question, I know it's something that they are curious about and has relevance to their own lives."

The group then launches into an activity using ice balloons—balloons that have been filled with water and then frozen. The educators pair up in separate breakout rooms. The facilitator instructs the pairs of educators to discuss what they notice about the ice balloons and what questions they have, practicing how to help youth develop testable questions. Sofia and Sandra point to a bumpy indentation that has formed on

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the surface of one ice balloon. They talk about testing out the question, "Do different types of salt melt the ice?" Another pair of educators asks, "What melts the ice faster, salt or sugar?" The pairs investigate their questions with the materials on hand, such as a flashlight, salt, food coloring, toothpicks, and paper clips. Then the pairs come back together in the large-group room to discuss their questions and process.

The session concludes with the facilitator telling the educators to record a short video of themselves practicing what they have learned about modeling science practices with the youth in their programs. The group will discuss these clips next month. The educators bid each other farewell and return to their settings: Sofia to her 4-H program in rural Maine, Sandra to her library in Minnesota, and the other educators to their sites across the country.

These educators have participated in the entire professional development experience virtually.

Though this scenario uses hypothetical characters, it offers a realistic example of how contemporary online professional development can be highly engaging, hands-on, and social. Video-conferencing software and intentional facilitation make it possible for participants to join in from their homes and offices around the country, using simple household materials in hands-on exploration. Though many people associate online learning with presentation-heavy webinars, recent improvements in technology have led to the development of professional development models that can be as interactive as in-person training. This article shares promising practices in virtual professional development for afterschool educators. Though our experience is with STEM professional development, our strategies can be adapted to other disciplines as well.

Accessible STEM Professional Development as a Growing Need

In compensation for the diminishing time spent on science in school, afterschool programs are taking an increasingly larger role in STEM education, with over 69 percent of programs in the U.S. offering some type of STEM programming (Afterschool Alliance, 2015). As the demand for afterschool STEM programs increases, so too does the need for trained educators and staff members. Access to high-quality, accessible, and inexpensive professional development is widely recognized as foundational to implementing high-quality programming that supports and enriches youth (e.g., Miller & Hall, 2007; Vandell, Reisner, & Pierce, 2007).

Though afterschool staff and leaders may appreciate how professional development benefits program quality, implementation brings a whole set of challenges (Bradshaw, 2015). Many afterschool educators do not have flexibility in their jobs to attend off-site trainings, or they work multiple jobs and so do not have the time to travel. One study found that, although afterschool staff generally found professional development useful, only 26 percent had regular opportunities to participate (Huang & Dietel, 2011). Some of the leading private funders that are looking to increase STEM capacity in afterschool programs have identified the need for "building the capacity of many more afterschool staff to implement and manage high-quality youth programs effectively" (Grantmakers for Education, 2016, p. 23).

Making Virtual Professional Development Fully Engaging

Virtual learning is an extremely promising way of overcoming some of the challenges of providing professional development to overburdened and underresourced afterschool staff in both rural and urban areas. The first implementation factor that can stand in the way of afterschool professional development, according to Bradshaw (2015), is time. She writes, "Effective professional development requires time—a commodity that is often in short supply in afterschool programs.… In addition to the actual training time, staff members need time for planning, practice, reflection, feedback, and collaboration" (Bradshaw, 2015, p. 47). In rural areas, distance and time constraints make it particularly difficult to bring afterschool educators together for interactive professional development. Lack of access to quality professional development leaves rural practitioners professionally isolated. Often they work with few or no other staff, so they have little opportunity to share ideas and practices. Urban educators face similar time constraints and are similarly overscheduled. Though they may not have to travel as far for professional development, the time spent sitting in traffic or navigating public transportation may be prohibitive. For both groups, virtual professional development can enable flexible ongoing learning and follow-up, a far more effective approach than a one-time professional development workshop (Darling-Hammond, Hyler, & Gardner, 2017).

Some providers simply post professional development materials on a website and assume that learners will acquire the target knowledge and skills by reading the materials. Though this approach is convenient for all parties, it relies on a high degree of participant self-motivation. It also assumes that people easily learn by reading or listening on their own, an idea that runs counter to the foundational assumptions of afterschool youth work.

A second, more engaging approach has been to create

webinars that bring learners into common online spaces to hear live presenters and ask questions. However, the anonymity and presentation-heavy nature of typical webinars can make it easy for learners to feel passive and to lose focus on the material (Brown, Hughes, Keppell, Hard, & Smith, 2015; Lobley & Ouellette, 2017). Our evaluation studies have led us to believe that social and experiential online professional development is more effective than asynchronous and solitary learning (Brasili, Allen, & Foster, 2017).

Fortunately, highly interactive virtual professional development is now achievable even for underresourced afterschool programs, thanks to inexpensive and widely available video-conferencing platforms such as Zoom, Google Hangouts, and GoToMeeting. Video-conferencing is like a video telephone call that allows users to connect "face-to-face" from different locations. Current video-conferencing platforms allow 25 or more participants at a time. Features such as breakout rooms, Brady Bunch–style gallery viewing, chat features, and screen sharing make online learning highly social and interactive. In addition, the increasing power and availability of digital recording devices in phones, laptops, and tablets allow educators to share videos of their work with youth in ways that simulate direct coaching. The technology is becoming more seamless, intuitive, and responsive to variable bandwidths, so that almost anyone with an internet connection can participate. For example, Zoom requires connectivity of 1.5 megabits per second for uploading and downloading. This fairly modest speed is available to over 90 percent of people with internet access, even in rural areas (National Broadband Map, 2015).

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Using such tools, online professional development can go well beyond didactic webinars or text-heavy materials with short quizzes. One area of potential growth is virtual coaching, in which an experienced coach or professional development provider supports the practice of one or more afterschool educators (e.g., Denton & Hasbrouck, 2009). Other areas are virtual professional learning communities and communities of practice, where groups of educators come together to learn from one another and share their work (e.g., Bang & Luft, 2016; Blankenship & Ruona, 2007; Fulton, Doerr, & Britton, 2010). Though much of the research and practice in these areas is happening in the world of schools, models are being adapted and developed specifically for out-of-school time providers (Hill, Matloff-Nieves, & Townsend, 2009; Vance, Salvaterra, Michelsen, & Newhouse, 2016).

A virtual professional learning community or coaching model could be implemented by providers at many different levels. Virtual communities may be an ideal option for statewide or citywide networks that already provide professional development to afterschool programs and want to reduce travel costs. Outside professional development providers can use video-conferencing to bring together diverse program staff from around the country. Challenges such as staff time, staff buy-in, and cost are ubiquitous (Bradshaw, 2015). However, virtual coaching can reduce some of these barriers and make sustained, social, and reflective professional development accessible to more providers and programs.

The introductory vignette is an example of a session in a contemporary virtual professional development program for afterschool educators called ACRES (Afterschool Coaching for Reflective Educators in STEM). ACRES was launched in 2015 as a project of the Maine Mathematics and Science Alliance (MMSA), funded by the National Science Foundation, the Noyce Foundation, and STEMNext. MMSA education specialists facilitate the program, and the MMSA research team, along with an external evaluator, studies the program development and impacts on participants. This online STEM professional development model is dynamic, interactive, engaging, social, and convenient for educators with limited time and flexibility. The promising practices for virtual STEM professional development we offer below are based on three years of repeated testing and evaluation of our model. We use the Zoom video-conferencing platform, so our examples refer to that tool, but many of the principles apply to other platforms with similar features. Our descriptions also incorporate links and pointers to previous evidence-based professional development resources and design principles.

Strategies for Developing Relationships Virtually

Though presentation-heavy webinars serve a purpose in that they provide easily accessible content instruction, one disadvantage is that participants have little opportunity to

get to know one another. Virtual collaboration allows participants from diverse settings to develop relationships and share practices (DuFour & Reason, 2016).

We have adapted a basic professional learning community approach, which brings groups of educators together to reflect on and improve their practice, to be used virtually with groups of afterschool educators. Our ongoing studies are already showing that this virtual model can be highly effective at creating a committed cohort of learners (Brasili et al., 2017). For example, in exit surveys, the majority of participants in these virtual cohorts agreed with the statement that they felt a bond with the group. They disagreed with the statements that "having the course online made it difficult to learn the skills" and "using Zoom was a barrier to getting to know the other people" (Brasili et al., 2017).

To achieve this success, we have used a number of intentional practices, shared below, to create a culture of support and trust as well as to facilitate relationship building among the cohorts of educators. These begin with the way we set up and structure the online sessions and move on to encompass the ways we encourage and support courageous and self-reflective conversations.

Initial Video-Conferencing Setup

Video-conferencing norms may not be intuitive to participants, so facilitators can offer clear guidelines and expectations like the ones outlined below to help participants get to know one another.

Choose a platform that meets your needs. Video-conferencing platforms, both paid and free, are widely available. Each has its own constraints and features. For example, the free version of Zoom, the platform we use, limits uninterrupted meetings of three or more individuals to 45 minutes. After that time, participants are automatically logged out of the meeting and need to log back in. Professional development providers on limited budgets may find a way to work this constraint into their model, if free service is the most important consideration. Others may find that having fewer limits is worth paying for. At this writing, the Pro version of Zoom costs about $15 a month. Some providers may already have access to a video-conferencing system within their network.

Encourage participants to enter their names on the screen. Zoom, like many other video-conferencing platforms, allows each person to put his or her name as a label; these "name tags" help participants get to know one another quickly and respond using names.

Suggest that participants use Gallery View. Facilitators should encourage participants to use Gallery View (which resembles the *Brady Bunch* title scene) as their default viewing option. In this view, each individual's face has an equal portion of the screen, placing the focus on the entire group rather than just the person speaking.

Suggest best practices for being visible to others. Being able to see each other's faces clearly can help participants build a sense of connection and enable them to pick up nonverbal cues. Sitting close to the camera can help to simulate eye contact. When multiple participants join from the same location, each individual should join from a different computer, if possible, with all but one audio signal muted to avoid feedback. If only one computer is available, participants should use a fish-eye lens or other method of fitting everyone onto one screen so all can be seen by others. Facilitators, particularly, must stay within the frame of view so they can be seen clearly.

Encourage participants to be careful with their lighting and setting. Participants will be easiest to see if they are not sitting in front of a window and if their screens have static rather than distracting backgrounds. The goal is not to be formal, but simply to create a comfortable and congenial space where participants can see and hear each other.

Virtual Icebreakers

Virtual icebreakers, like their in-person counterparts, help participants get to know one another. Icebreakers can foster a social and enjoyable learning culture and set the tone for the learning journey on which participants are about to embark (Mind Tools, 2016). Here are two icebreakers that work well in a virtual setting and are relevant to the purpose of the work:

- **Your space in ten words.** Ask participants either to share ten words to describe the room they are in or to give a video tour of their space. This activity normalizes the fact that participants are joining from diverse settings that may include homes, offices, libraries, or coffee shops.
- **Who is most likely to interrupt you?** Participants can respond either in the chat box or orally to this question. Answers might include, for example, "my partner" or "my cat." Again, this activity normalizes the diversity of participants' settings and can reduce anxiety in a lighthearted way.

Cohort or Group Size

We have found that a group of six to eight participants plus the facilitator is large enough for dynamic conversations but small enough to allow participants to get to know one another and participate fully. With a group of this size, all

participants remain active and can contribute at any moment. A small group size also allows facilitators to monitor the participation and nonverbal cues of the participants effectively. Just as in a live session, facilitators who notice confused facial expressions or other signals can check in with participants verbally or in a private chat note.

Strategies for Facilitating a Dynamic Discussion

Once the basics of video-conferencing are in place, facilitators can focus on the more challenging goal of supporting authentic and productive discussion. A central component of ACRES is discussion of one's own and others' practices. In virtual learning, facilitating such potentially sensitive discussions can be especially challenging. Below we describe strategies that have allowed us to facilitate interactive virtual discussions effectively.

Support Discussion at Various Scales

Advances in video-conferencing have made it easier to facilitate engaging group discussion and interaction. Many software packages offer the features outlined below.

The chat box can be used for personalized discussion with individual participants. A person can send a message to the entire group; alternatively, a message sent privately to another individual acts as a "virtual whisper." Participants can type their questions into the chat box without interrupting the flow of the conversation. Often participants use the chat box to share resources or thoughts that come up during conversation.

The polling feature can capture sensitive information at the individual level. Many platforms allow facilitators to set up multiple-choice questions that participants can answer anonymously. Polling can help facilitators gauge how group members feel about a particular topic, such as their confidence or degree of experience, without putting anyone under personal scrutiny.

Breakout rooms allow participants to talk privately in pairs or small groups. As in in-person training, breaking participants into small groups enables everyone to talk without the pressure of speaking in front of the whole group. Facilitators can quickly and spontaneously assign participants to separate breakout rooms; participants can talk in small groups and show each other their hands-on creations by pointing their cameras at their materials, as Sofia and Sandra do in the opening example. This structure parallels the popular think-pair-share strategy used in face-to-face trainings. Facilitators can drop into each breakout room to monitor the discussion, effectively mimicking the norms of entering and exiting a physical space, and then bring everyone back into the main room with a single click. As one ACRES coach wrote about breakout rooms in Zoom, "I think it's a great way to have small-group conversation…. It's powerful because it helps to change up that video webinar format. Just like in a face-to-face setting, you wouldn't just lecture; you'd get people into small groups."

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Whiteboards can be set up to elicit everyone's ideas at once. Facilitators can provide prompts or questions to which participants respond by writing, drawing, or typing into text boxes on the virtual whiteboard. The group can then reflect on what members wrote, look for patterns, and cluster the ideas that surface, much as they would in a face-to-face "sticky notes" activity.

Screen sharing allows people to share thinking processes and behaviors. At any time, the facilitator or participants can share a window on their screen with others. In the ACRES program, the coach used screen sharing to pull up a database of vetted STEM activities and show participants how to navigate it. Also, as bandwidth allows, participants can screen-share videos of their work with youth so that the group can talk about facilitation practices in relation to authentic examples and not just general principles.

Actively Facilitate Conversation

Because virtual discussion may be relatively new to many afterschool staff, we usually facilitate discussions quite actively to ensure that all participants have equal opportunities to share. In the ACRES project, after viewing a video of an educator's practice, we ask every participant to share one strength and one opportunity related to the targeted skill. Participants may pass, but everyone has space to share, so that no one person dominates the conversation. One coach reflected:

> I think about webinars that I'm on sometimes, and it's just someone talking to you all the time. So people naturally think, "I have this email to write..." et cetera. The way that we've done ACRES is that we've designed

it with the intent that participants are active learners. I've never caught anyone multitasking because of the way it is built.

The fact that everyone is expected to participate in discussion reduces the risk that someone will "hide behind the screen" or not engage fully.

Strategies for Instructing STEM Education Virtually

When the strategies for building relationships and facilitating discussion—strategies that apply to any virtual learning—are in place, then providers can focus on developing the target skills and knowledge. In the case of ACRES, coaches help afterschool educators develop effective STEM facilitation skills.

Focus on Facilitation Skills

Afterschool educators engage program youth in a wide variety of activities across a range of STEM topics. A plethora of websites, such as HowToSmile.org and StarNetLibraries.org, offer vetted STEM activities that educators can implement. We saw a need to focus ACRES courses on helping educators develop skills to engage youth in STEM learning in general, rather than showing them how to teach about discrete STEM topics, such as plant biology or physics. ACRES courses follow the "strands of science learning" framework developed by the National Research Council (2009) to outline goals for effective STEM learning in informal settings (2009). These strands include actions by youth such as participating in scientific activities and learning practices with others, testing and exploring the natural world, and building STEM-related identities. To reach these science learning goals, we engaged the afterschool educators in learning and practicing effective facilitation skills. We adapted skills drawn mostly from the professional development site Click2SciencePD.org, which has identified a set of research-based STEM facilitation skills that respond to the needs of afterschool educators (Morones, 2014).

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Though facilitation skills can be learned in person, this skill area is particularly appropriate for virtual professional development. Because participants are likely to come from a wide range of programs in different states or regions, they can share diverse experiences and viewpoints. They need not focus on specific content or activities, so that they also need not have specific materials or tools to practice those activities or content. They can apply the facilitation skills they learn to whatever activities they are currently teaching at their sites, whatever the ages of their youth.

Learning and reflection on skills also allow educators to participate fruitfully no matter their level of STEM competence. People don't have to be well versed in chemistry or biology, for example, in order to participate in sessions on modeling science practices or giving youth voice and choice in STEM programming. One ACRES participant stated:

> This course was very valuable to me…. I've never even run a science program before, and I'm in the process of establishing a STEM club, and so this has been the catalyst and has given me the confidence to do that.

Focusing on facilitation skills, rather than on specific STEM topics, helps participants to approach STEM more confidently, in a spirit of inquiry and problem solving.

Incorporate Hands-On Activities

STEM professional development often includes hands-on activities that allow educators to practice how to implement a skill or topic with youth. Though doing hands-on activities in virtual professional development may seem counterintuitive, in fact the available video-conferencing tools allow participants, working in small or large groups, to use their cameras to show other participants what they are working on. As in face-to-face training, group members can collaborate by offering suggestions and comments as they create or test. In the introductory vignette, for example, Sandra and Sofia are alone in a Zoom breakout room, while other pairs of educators are in separate rooms. They are using the ice balloons they prepared in advance to discover how to develop testable questions, using common household items they also gathered in advance. Though Sandra and Sofia are working in their own offices half a continent apart, they position their cameras so each can see what the other is doing to her ice balloon. Through their audio connection, they share their ideas and discuss their questions.

When planning for hand-on activities, facilitators should stick to simple activities that are easily adapted to

other contexts, using common materials people are likely to have in their homes. Materials and prep lists for activities should be sent ahead of time so participants can gather materials. Complex activities that require a lot of time, money, and preparation are not appropriate for virtual professional development, nor are they necessary when the professional development focuses on facilitation skills rather than content. The hands-on activity itself is not the main focus of the training; rather, it provides the context for a discussion of STEM facilitation skills.

A final advantage is that hands-on activities offer another opportunity for participants to build relationships. The collaborations are usually lighthearted and creative, providing a welcome break from the intensity of abstract group discussions.

Challenges of Virtual Professional Development

Though the strategies we shared above have been effective in building relationships, facilitating discussion, and teaching STEM facilitation skills, ACRES virtual professional development has not been without its challenges. Technology issues can always hamper the success of otherwise exemplary virtual professional development. Leaders must give extra attention to communicating instructions, testing their equipment beforehand, and preparing backup strategies or workarounds for the most common problems.

One frequent challenge, especially in rural areas, is bandwidth limitations, which can lead to participants being disconnected from the video-conference. Zoom and some other platforms automatically adjust to limited bandwidth by lowering video resolution. However, occasionally participants with spotty internet connections have difficulty staying connected. In such cases, we encourage participants to join the video-conference on their webcam but to turn off their computer volume and instead call in on their phone or, in the worst case, to call in without video. Recording a session for later viewing is another easy backup strategy that can help participants who miss all or part of a session due to internet glitches.

Another challenge is that participants often are not experienced or comfortable with the technology. To address this challenge, we have put together several step-by-step guides, with screenshots, on how to use Zoom, DropBox, and other technology. In addition, facilitators offer people the opportunity to test the technology privately before the course begins. This simple "tech check" helps participants work through any anxiety they have about using a technology for the first time. Finally, facilitators prepare in advance so they can troubleshoot issues that arise. If someone's microphone doesn't work, or if there is annoying audio feedback, facilitators are prepared to lead participants through several steps to diagnose and resolve the issue.

Still, even tech-savvy facilitators cannot anticipate every glitch. Sometimes software and hardware just don't work the way we anticipate. It helps to keep the sessions lighthearted and to be grateful for participants' acceptance of technology's bumps and flaws and for their commitment to learning. Interestingly, we have found that virtual participants are open to helping each other—and even the facilitator—to resolve technology issues. As long as the facilitator stays calm and encourages a spirit of "figuring things out together," groups seem surprisingly resilient. We also encourage participants to reach out for local technology support from tech-savvy family members, colleagues, friends, or program youth.

Going Beyond STEM

The virtual professional development strategies and techniques presented here can be adapted to a variety of other learning needs for afterschool educators. One colleague of ours (Jennifer Brady, personal communication, May 20, 2018) recently adapted the model for professional development in literacy with afterschool educators in a rural area. During midwinter, she inserted two Zoom sessions into a seven-part in-person workshop series as a way to continue the momentum during a time when travel is difficult. The facilitator found the breakout rooms particularly helpful for continuing a "critical friends" practice started during the in-person sessions. Another strategy the facilitator used was to screen-share a website of literacy practices and then have the group work independently in a separate browser tab to look for strategies related to their own sites. The facilitator reported that most participants appreciated the opportunity to collaborate in highly active and flexible small groups. She added her opinion that the online professional development model presented in ACRES could be adapted to any other discipline, regardless of content (Jennifer Brady, personal communication, May 20, 2018).

The best online professional development alleviates some of the greatest obstacles faced by afterschool educators in attending face-to-face trainings, while retaining components that make learning effective, such as group bonding, a safe learning environment, a variety of activity formats, hands-on components, and opportunities to engage in deep reflection on one's own and others' practices. We hope that other providers will use the strategies in this article to make their online professional development dynamic and useful for their virtual participants.

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