Adapting video-based reflections to afterschool settings
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Introduction

The role of afterschool programs in STEM education is being taken ever more seriously as the teaching of science in schools has dropped in response the accountability requirements of NCLB and ESSA. As classroom time for science education has decreased, parents and communities are seeking to supplement their children's exposure to STEM via afterschool programs. In response, afterschool programs have ramped up their STEM efforts; 69% offer some type of STEM programming (Afterschool Alliance, 2015.) Afterschool programs are growing rapidly, and serve over 10.2 million children in the US annually (Afterschool Alliance, 2014).

As the demand for afterschool programs continues to grow, so does the need for accessible, inexpensive professional development. Despite being increasingly charged with facilitating STEM learning experiences for youth, afterschool educators often receive little or no systemic professional development at all. For two decades, the Noyce Foundation (more recently, STEM Next) has been a champion of high-quality PD for afterschool educators in STEM, and it is their funding that made possible the work described here.

Through a Noyce Foundation grant to the Maine Mathematics and Science Alliance, and with the University of Maine Office of Extension faculty as implementation partners, we have developed a series of professional development experiences that allow out-of-school educators to video their own work with youth and upload the videos to a shared space. A coach then guides the group to view and critique each other's videos through the lens of specific facilitation skills practiced over time. All group discussion takes place over zoom video-conferencing. We are conducting design-based research on the work as it evolves.

Theoretical Framework

Our model for advancing the skills of afterschool STEM educators integrates research and practice from three subdomains:

1) Professional learning communities (PLCs). PLCs have become increasingly widespread formats for teacher professional development in school districts (e.g., Spencer, 2016; Sims & Penny, 2015). Essentially, a PLC involves a group of educators coming together with a common set of goals to reflect on and improve their teaching practices (Britton et al., 2010, Blankenship & Ruona, 2007). Research has shown the power of PLCs to change teacher practices, such as paying more attention to students' reasoning, and using diverse modes of engaging students (Britton et al., 2010), skills that would translate very well to the out-of-school world.
2) Instructional coaching. Our work also draws from the increasing use of Instructional Coaching (Denton & Hasbrouck, 2009). In this approach, a skilled leader helps teachers

learn and apply new teaching strategies in their own work, again in an atmosphere of collaboration and reflection. While much remains unstudied in this area (Blazar & Kraft, 2015), several studies have shown its power to improve teacher practices and student achievement (Allen et al., 2011; Blazer, 2014).

3) Digital technologies. The third key component of our model is that it uses inexpensive personal recording and communications technologies to make the Instructional PLCs work for blended and fully online groups.
   a. Video recording: Digital recording devices in phones, laptops, and tablets are now ubiquitous, allowing community-based educators with low budgets the tools to make recordings of their own interactions with youth and share them with colleagues.
   c. Video annotation tools: Similarly, there are inexpensive and easy-to-use tools that allow users to upload videos to a shared private space, annotate the videos and share their comments with each other.
   b. Online learning: Most important of all, videoconferencing platforms such as Zoom has features such as instantly-allocatable break-out rooms and gallery viewing, that allow for an online experience that is highly social and interactive.

Target skills

Drawing our pedagogical approach from all of these subdomains, we designed a professional development course to focus on a small set of STEM skills that would be of greatest value to afterschool educators. We chose skills that were supported by research as being fundamental to strong pedagogy, appropriate for informal settings, and applicable to a broad set of activities and youth. We drew from a range of sources, including the University of Nebraska's Click2Science framework for STEM skill-development in afterschool settings (www.click2sciencepd.org), the NGSS practices in science and engineering, the Dimensions of Success framework for quality in afterschool settings (Shah, Wiley, Gitomer & Noam, 2013), and the formative evaluation work of Black and William (e.g., 2009). The skills were: asking purposeful questions, modeling the engineering design process, modeling science practices, giving youth voice and choice, and supporting relevance, identity, and careers.

Structure of professional development modules

For each skill the professional development module had the same basic structure:

1) Introduction
   a. skill definition + discussion of video exemplar
   b. coach models skill during hands-on activity
   c. sharing of concrete strategies
2) Practicing the skill
   a. try skill with youth
   b. video record self
   c. edit and upload
3) Getting coached
   a. framing own video for peers to understand
   b. hearing feedback
   c. doing the same for others

This structure was designed to emphasize immediate application of the new skill in authentic afterschool settings, to make the PD as relevant and useful as possible to the participants. With

the 3 components to each module, we estimate that participants needed to give 4-6 hours of time to the PD, beyond their normal time working with youth.

Research

Our ongoing design-based research focuses on principles for adapting key design principles of instructional coaching and professional learning communities to the world of STEM educators outside schools, in settings such as 4-H Clubs, public libraries, or 21st Century Community Learning Centers. The research asks: What principles of video-based instructional coaching, especially its technological supports, can most effectively build STEM facilitation skills by educators in this vital sector of a learning ecosystem?

Methods

Between 2014 and 2017, we studied 11 cohorts of afterschool and out-of-school educators who participated in coaching courses using the video-based PLC model. For each cohort, we interviewed (and surveyed a subset of) all willing participants both before and after the course. The interviews focused on: a) responses to general design-features such as length, number, and timing of the STEM facilitation skills b) self-reported impacts such as changes in confidence, use of targeted skills with youth, and c) the ways participants thought the technology supported or hindered their ongoing self-reflective practice.

Selected findings

In terms of technology supporting a self-reflective community, several design features emerged as important in supporting the learning experience:

a) *Internet speeds*. The study was conducted in rural settings where internet speeds were usually adequate for online discussion, but upload and live-streaming could be slow. In such cases, groups showed creativity in attempting workarounds (e.g., joining the discussion by phone for the non-video parts, experimenting with quicker upload platforms, getting help from the coach or other community members).

b) *Audio quality*. Because the course emphasized dialogic skills such as "asking youth purposeful questions," it was important for the coach and peers to be able to hear what the youth were saying in the video recordings, if they were to offer appropriate feedback to the educator. With external microphones being too expensive for scalability of the model, educators became creative in finding ways to capture decent audio in their own settings (e.g., splitting off a sub-group of youth into a separate space, designing for whole-group conversations, or using selfie-sticks to capture small-group work with youth.) Also, some coaches strongly encouraged the participants to upload and watch each other's videos prior to the live streaming in the group context. This was in tension with the time constraints the educators faced. When participants could not hear the youth well, discussion sessions tended to drift toward general principles of facilitation, and peers provided positive reinforcement rather than focused critique. This may have contributed to the finding that 30% of the participants felt there was too little "stretch" for them in the course (as opposed to only 2% saying the reverse). Participants valued both clear audio and highly structured supports for their critiques.

c) *Video selection and editing*. To minimize the storage needed on participants' recording devices, as well as the need to edit, educators were asked to record "about 3 minutes" of video showing their practice of a specific skill. However, many educators recorded longer

periods and enrolled the help of knowledgeable others in their communities to edit and upload them. In some cohorts this led, unfortunately, to an escalating expectation among the group of videos needing high production values and showing strong practice rather than areas for learning.

d) *Blended and fully virtual versions*. For fully virtual cohorts, the coaches used break-out rooms to support pair-wise discussions and even hands-on activities. Most participants said they would prefer an in-person workshop for learning the skills, but even the fully virtual cohort participants rated the course as highly rewarding and reported strong cohort bonding.

While initial recruitment was a significant challenge, the model was extremely highly rated by those who did participate. In all, 96% (N=44) said they would recommend the course to a colleague, and 93% said they would be interested to take an additional course in the same format. Also, 89% (N=44) reported that the course changed the way they worked with youth, particularly citing their increased use of the target skills.

Conclusions

The intersection of PLC's, instructional coaching, and ubiquitous technologies shows promise for providing STEM professional development to informal educators such as afterschool providers. The model has particular value in rural communities where great distances make in-person workshops unrealistic. Even facing technology limitations, participants may find creative work-arounds, particularly if coaches encourage them to draw on local funds of knowledge (Gonzalex, Moll, & Amanti) to aid in recording, editing, uploading, and sharing their videos.

[Note: A more extensive write-up of this work is currently in preparation for submission to the Journal of Research in Science Teaching.]

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