SYMPOSIUM

Beyond the Brown Bag: Designing Effective Professional Development for Informal Educators

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Synopsis  Most researchers are keenly interested in disseminating their work beyond traditional publication routes. With an eye to increasing broader impacts, scientists can benefit from partnerships with informal educators who interact daily with the public and see their role as translating science to increase the public’s intellectual and emotional connections with the natural world. Typically, researchers give a one-time lunch hour talk, generally a modified version of a presentation aimed at scientific peers. Talks during which scientists show slides and interpreters mainly listen are a missed opportunity. They leave the scientist no wiser about the public’s interests and the nagging questions interpreters have. Such talks leave the conscientious park educator with insufficient resources for overcoming challenges in interpreting the science for the public. The Interpreters and Scientists Working on Our Parks (iSWOOP) project proposes a model of professional development (PD) that involves a deliberate partnership where scientists and educators work together. During site-based PD sessions, they tease out the relevance to public audiences and begin to develop programs about the science. This article describes iSWOOP’s approach to supporting productive collaborations that promote an understanding of scientific research to public audiences. Results from a pair of surveys indicate that both sides of this partnership benefit from extended contact and clear communication.

Introduction  National parks are our nation’s “laboratories” for scientific research. This nearly invisible function is driving us to learn how to help National Park Service (NPS) interpreters move science from static facts to a lively exchange based on scientists’ current, park-based research.

The Interpreters and Scientists Working on Our Parks (iSWOOP) model brings together dedicated scientists, passionate NPS rangers, and talented STEM education researchers who are committed to expanding STEM learning opportunities at our nation’s parks (Fig. 1). The project has the potential to transform the way the NPS Division of Interpretation and Education leverages site-based science, the way its education rangers (hereafter called interpreters) communicate site-based science to the public, and expands opportunities for scientists to make their efforts visible to the public. Interpreters may be experts at interpretation, but not on the particular science they are communicating. In the mid-2000s, Hristov and Allen noticed the missed opportunities to highlight cutting-edge science about the Brazilian free-tailed bats. Without exposure to scientists, interpreters relied on ranger lore and Internet searches, which sometimes resulted in dated information or facts true of other species, but not the free-tails that the public gathered to watch. This has been ongoing, ever-present conundrum with a variety of proposed solutions (Macdonald 2013; Melena 2015).

Interpreters have a pressing need for first-hand knowledge of site-based research initiatives (Char 2015). However, the typical format for briefing park staff about research is a one-time lunchtime research
talk to a group of rangers, with little opportunity for two-way conversations or hands-on experience. iSWOOP affords new structures to foster interactions among scientists and interpreters. The public regards interpreters as trusted sources for information, even on sensitive topics like climate change (Pew Research Center 2015). When confident, knowledgeable, and equipped with a repertoire of strategies, interpreters have the potential to engage tens, and ultimately hundreds of thousands of park visitors in learning about park-based science, multiplying the broader impact of the collaborating scientists well beyond what they might achieve themselves (Merson et al. 2017).

Scientists are ideal partners in developing interpreter skill sets and knowledge around the science they are tasked with communicating. Scientists are in a position to make a difference, but how do they make a difference, particularly in a complex bureaucratic system that features high levels of staff turnover? Here, we describe the iSWOOP model of professional development (PD). We ask: What aspects of iSWOOP’s PD model are valued by interpreters and scientists? We regard effective PD as the precursor to changes in practice that allow meaningful opportunities for the public to become aware of park-based research. We posit that effective PD requires effort and time to allow interpreters to explore the body of research and then to create meaningful opportunities for the public while in dialog with the scientist.

The iSWOOP model
iSWOOP adopted activities and approaches used extensively in inquiry-oriented PD workshops for informal educators in zoos and science centers (see Building Math Momentum in Science Centers, NSF Award No. 0229782, https://nsf.gov/awardsearch/showAward?AWD_ID=0229782). We piloted iSWOOP PD at Carlsbad Caverns and refined the model, adapting as needed to meet circumstances at new park units across the country. The structure of the model includes multiple touch points, modeling, and opportunities to do science. Practitioners’ questions shape the agenda. An emphasis on visualization dovetails with interpreters’ mission: to reveal the resource and make meaningful connections with significant cultural and natural resources (Tilden 1957; Ham 2013). In this case, scientists and interpreters tease out the story of the researcher, previous lines of work, and explore the relevance of the research within and beyond park boundaries (Firestein 2012).

Interpreters and researchers convene for multi-hour sessions over 3–5 days. The sessions begin with listing questions about the natural resource (Table 1). Interpreters list questions that nag at them, and also those that visitors ask repeatedly or are otherwise memorable. The questions shape subsequent sessions. Scientists demo their high- and low-tech instruments to explain how we know what we know. A block of time is also dedicated to hands-on experience. Interpreters assist with data collection, gaining firsthand experience with the tools, frustrations, and workflow. The sessions include an overview of the visualizations scientists use to make sense of their data, e.g., graphs, 3-D models, contrasting slides of the phenomenon under different conditions, and animations. Interpreters craft a program. They imagine a setting for their interactions with the public, a hook, and open-ended questions to encourage observation, prediction, and speculation. The PD culminates with a run-through of new programs during which all participants offer feedback, clarify scientific points, and suggest ways to heighten engagement, suspense, and curiosity.

Given the intensity of the commitment, we set out to determine the extent to which this investment pays dividends for both scientists and interpreters. Both iSWOOP evaluators’ studies and the literature on PD speak to the benefits of a multi-session model that prioritizes exchange, first-hand experiential learning, modeling of interpretive techniques, as well as new content.

Research underpinning the iSWOOP approach
From the outset, iSWOOP relied on interpreters as well-positioned intermediaries for STEM learning.
The literature on interpretive aims speaks to their strengths as credible conduits for scientists’ work (Tilden 1957; Ham 2013). To inform the iSWOOP model, we also surveyed available literature about effective PD designed to build educators’ content knowledge and increase their use of inquiry-based approaches to STEM topics. Three themes stood out related to bolstering educators’ ability to facilitate STEM learning: (1) the importance of authentic practice of science, (2) the need includes but is not limited to new content, and (3) effective PD takes time. By “practice” we mean shadowing scientists as they work or independently engaging in designing experiments, refining questions, and conducting fieldwork or analysis. We specify “authentic” to indicate that the activities contribute to research and are not solely for the sake of demonstration. In most PD, acquiring new understandings and participating in authentic practice overlap. For example: Falk and Drayton (2006) found that teachers’ increased self-perceptions of their own scientific understanding resulted, at least in part, from their authentic practice of science during a year of research with ecologists (1997). Nevertheless, we discuss these themes separately.

(1) Authentic science practice

To provide meaningful science experiences for students, educators need quality science experiences themselves from which to draw. Researchers emphasize the importance of educators engaging in science investigations and experiencing the same approaches that they will adopt with learners (Rosebery and Warren 1998; Bevan and Xanthoudaki 2008). PD sets precedents for participants to draw less upon the traditional techniques associated with K-12 rote learning and more on inquiry-based techniques appropriate to fostering learning in an informal setting. In their comparison of three workshop models with a museum component, Melber and Cox-Petersen (2005) found teachers participating in the model which combined museum and field-based activities gave it the highest mean rankings. Teachers who participated in workshops with a field component reported specific elements that helped them understand the process of science.

(2) Limitations of new content

The need for PD includes but is not limited to new content (Tran and King 2007). Several studies have found that content coverage may lead to improved confidence without corresponding increase in competence (Sukow 1990; Smith et al. 1998). In a study of 376 programs in 24 units of the US NPS, interpreter confidence was associated with visitor satisfaction and lack of confidence with visitor attrition. However, the walking encyclopedia approach was also associated with visitor attrition (Stern and Powell 2013).

Because their audience members may not want to think hard about complex numerical information (Bruine de Bruin et al. 2017), equipping interpreters with only facts, statistics, or numerically expressed relationships may cause visitors to turn-off. Some audiences will focus on qualitative communication more than on quantitative communication (Canfield et al. 2017). This makes the interpreters’ job of revealing the significance of a resource to the public particularly challenging (Tilden 1957; Ham 2013). The antidote? Scientists’ ways of looking at resources can provide revelations about structure, function, and dynamic interactions that can be communicated qualitatively. Effective PD assists
interpreters in integrating new knowledge and delivering it with appropriate techniques including stories, props, quotes, and images. Ideally, techniques increase engagement, visitors’ appreciation of the relevance of research, and make the material memorable. While content knowledge is a component of successful interpretation, it must be tempered with an assessment of audience members’ interest and likely saturation point.

(3) Time commitment
Effective PD takes time and a sustained effort (Yoon et al. 2007; Loucks-Horsley et al. 2010). Studies of PD find that one-time interventions are less likely to shift practice than when educators have multiple opportunities to encounter new content, to meet with peers, and to engage in discussion and practice in adopting new content and approaches (Garet et al. 2001; Melber and Cox-Petersen 2005). An example: nature center staff who participated in PD programs where they were provided with resources to work on the topic over time were more likely than staff at non-participating centers to be comfortable with and provide climate change education programming (Swim et al. 2017).

When scientists and interpreters have the opportunity to meet and work collaboratively the outcomes are impressive. For example, the NASA-NPS Earth to Sky Partnership’s science and communication courses feature NASA scientists as presenters who are coached by experienced interpreters, and who participate in class discussions. Evaluators tracking three cohorts of participants over the course of 2 years determined that over 4 million National Park and Wildlife Refuge visitors were reached by participants with content derived from the courses, and that they provided training on course content to over 2,000 additional educators (https://www.earthtosky.org/professional-development/effective-training.html). Halversen and Tran’s COSIA project (2010) gives an entire semester to fostering collaborations among ocean scientists and informal educators to foster students’ science communication skills.

With these considerations in mind, iSWOOP project leaders designed a PD model for National Park Interpretive rangers that is based on: (1) participation in authentic science practices, (2) direct contact with time for exchange of stories, questions, and information, and (3) science content conveyed with relevance and that models interactive techniques.

Overview of two studies
Using a mixed methods approach which collects and analyzes both qualitative and quantitative data (Creswell and Plano Clark 2007), the project evaluator and principal investigators have been studying the project’s PD at three national park units located in the southwest, northeast, and midwest. In each park site, between 8 and 15 interpreters attended PD sessions along with interested others (such as administrators, communications staff, and resource managers). The groups gathered for roughly 15 contact hours spanning several days. Scientists’ attendance ranged from 3–15 h. Data were gathered following PD through a survey for interpreters (Study 1) and a survey for scientists (Study 2).

Quantitative data yielded from rating scales were analyzed using frequency distributions and descriptive statistics. Prose responses to open-ended questions were coded by a member of the evaluation team, using a grounded theory approach (Patton 2002; Charmaz 2006) using thematic categories in alignment with the main features and goals of the project.

Study 1: Interpreters’ feedback on iSWOOP PD
Methods and sample
On the last day of training, participants from three National Park sites (n = 37) completed an anonymous 15-item survey designed to gauge their impressions of the relevance of skills and content covered. Interpreters rated the value of PD components and made recommendations for future sessions.

Results
Overall, interpreters greatly appreciated the training’s featuring of scientists and park-based research. They embraced the idea of engaging visitors in conversations about park-based scientific research. As one interpreter commented on the applicability of iSWOOP’s PD:

The concept of this project is great. I think we often aspire to interpret current research, but often fall back on more general information and/or synthesize research for visitors. The focus on actually engaging visitors with the data has great potential both for making current science more accessible to the visitor and in contributing to helping the public to become more scientifically literate.

Participants’ feedback underscored the value of the PD in terms of (1) increasing their grasp of park-based scientific research, (2) strengthening relationships with featured scientists, and (3) acquiring the skills to make conversations about research interactive. The training prepared interpreters to speak confidently about park-based research.
I thought this was valuable professional development, especially in the life of interpreters. There’s always a disconnect between scientists/academic way of speaking and (my) tendency to “over-simplify” research. iSWOOP is a means by which we can truly meet visitors on their level.

Over half (20 interpreters, 54%) of interpreters cited their classroom-based and field-work with the scientists as the most valuable aspect of the PD. Interpreters reported that the training content strengthened both their knowledge and skills. Twenty-nine (29) out of 37 interpreters (78%) agreed that training had given them new knowledge to apply in their work. Nearly, two-thirds (23 interpreters; 62%) agreed that the training had given them new ways to look at their interactions with visitors. Over half (20 interpreters, 54%) agreed that iSWOOP PD had increased their skill facilitating discussions of visualizations, research, and relevance of scientific research to visitors’ lives. Similarly, they felt equipped to tell stories about how scientists know what they know.

Interpreters expressed a desire for continued communication with the featured researchers. Among the recommendations were requests for more—contact with more researchers, over longer periods of time, and with more opportunity for informal exchanges. Almost half (17 interpreters, 46%) identified maintaining a connection with scientists and updates on the research as the primary request for ongoing support.

**Study 2: Scientists’ perspectives**

**Methods and sample**

Evaluators sent a survey to the research scientists who had shared their research during PD sessions. All but one of the eight surveyed also contributed material to the visual library and met multiple times with project leaders. The 8-item survey addressed the reasons scientists might choose to become involved, the potential professional benefits and outcomes of the project, and suggestions of how the project model could be improved. Surveys were administered after PD sessions had occurred.

Eight of the nine research scientists involved in the iSWOOP during the first 2 years of the project completed a survey. The scientists represented five different universities and a variety of scientific departments (e.g., biology, geology, paleoecology, and earth/climate sciences) and included two assistant professors, two associate professors, three retired (emeritus) professors, and one post doc researcher.

**Results**

Scientists were enthusiastic about the potential benefits. Their comments ranged from personal gain to following through on a commitment to a larger societal benefit.

To me, it seemed like a win-win—I get to get my message out there, and the park gets to tell stories about the “what” and “how” of science. It’s also important for people to know that parks aren’t just beautiful or fun; they’re also important natural resources, and a lot of research is happening in them . . .

Seven of the eight scientists indicated that they had gained something professionally valuable from the project. Benefits described by the scientists were varied, and included: an increased professional network of colleagues, improved communication skills, a deeper understanding of working with parks and park interpreters, and greater appreciation of visitor perspectives and the importance of out-of-school learning.

At least half (four to five out of eight) of the scientists identified four different areas in which they reported the project had impacted them either “moderately” or “extremely.” These areas were: (1) broadening their impact by reaching new or larger audiences for their work; (2) adding to their repertoire of teaching strategies; (3) increasing the ways they will work with NPS or interpreters in the future, and (4) changing how they see visitors’ or interpreters’ perspectives on their work.

The main project feedback offered by the scientists suggested greater attention to three areas: identify ways to minimize the time commitment, improve project communication between the various project partners, and explore different ways in which they could get greater credit or recognition for their involvement and contributions to the program.

**Discussion**

The results show that iSWOOP PD delivered welcome benefits to its participants. For interpreters, benefits were tied to accomplishing their job. For scientists, the benefits were varied. Expanding their repertoire of strategies for explaining their research or gaining additional visuals to illustrate their work were mentioned along with the opportunity to contribute to a community beyond their students and institutions.

Overall, interpreters greatly appreciated contact with scientists, and the idea of actively engaging visitors in data from active scientific research.
Interpreters expressed a desire for more continued communication with the featured researchers. Attesting to this point—among the recommendations were requests for more, e.g., more researchers, more contact over longer periods of time, and more informal exchanges were desirable. This however sets up a fundamental conflict between key participants (e.g., interpreters wanting more time and scientists wanting to commit less time). In order to address these tensions, we have advocated for increased “soft” collaborative time, including spending time together at meals during the span of PD and for continued communication in a way that is respectful of the scientists’ time (e.g., many scientists have twitter handles that the interpreters can keep up with and communicate with while also moving the conversation to the public realm).

iSWOOP has not solved all of the challenges associated with science communication happening in parks. Interpreters and scientists recognize the challenges: visitors with a wide range of ages, science interest and understanding, and motivation for their visits. Intergenerational groups on vacation with a specific recreational goal can be a challenge to talk to at length about current research. In asking for more researchers and more contact with researchers, interpreters conveyed their need to meet visitor interests, to leverage place-based interest, and the depth of knowledge needed to manage these dynamics in formal and informal interactions. In the face of these challenges, iSWOOP PD appears to increase interpreter content knowledge, and provides visualizations and stories which can be used to hook audiences, maintain their interest, and forge connections.

Models for PD of this sort also need to consider managing both logistics and varied expectations. For example, expectations and benefits need to be clear and realistic. It is helpful to agree upfront on whether everyone who participates in PD will also be expected to interpret the science. Will interpreters have access to scientists or other supports as they refine their programs and introduce the featured scientists’ content? How will scientists’ contributions be credited in ways that are meaningful to them?

The iSWOOP project takes as a given that individuals may enjoy the PD and will have constructive criticism, but find reasons not to adopt the approaches. Interpreters have offered numerous suggestions for improving the PD. Meeting their needs is a high priority, yet the needs are varied for new and seasoned interpreters and those whose style is more factual versus conversational or narrative-driven. Even with park-specific, job-, and park-relevant PD, some participants will find reasons not to adopt the content or strategies covered in iSWOOP PD. Hord et al. (2006) delineate seven kinds of concerns (Stages of Concern or SoC) that users, or potential users, of an innovation may have in their concerns based adoption model (Table 2). It is ultimately up to interpreters’ supervisors to shepherd the adoption process. However, the project has tried to anticipate concerns and proactively plan PD activities to address them, such as practice sessions with feedback from PD leaders and featured scientists.

There are several limitations of these studies. The process for structuring PD is still being refined and implementation at different parks is not identical. Respondents did not have an equal stake in the project or its outcome. For example, one of the scientists had been involved peripherally and two of the scientists had joined the project as consultants on visuals rather than in the role of featured scientist. Some PD attendees were expected to develop formal programs based on iSWOOP training while others had the option to use iSWOOP approaches or not.

However, given that effective PD prioritizes (1) doing science together, (2) increasing interpreters’ science content and first-hand experience with science process, (3) time for exchanges that meaningfully benefit interpreters and scientists, iSWOOP evaluators and researchers continue to collect data so that those aiming to implement iSWOOP approaches can address interpreters’ and scientists’ needs.

Conclusion

A common format for exchanges between interpreters and scientists involves a researcher giving a one-time talk, generally an adaptation of a presentation for peers or students. The scientist may speak with the implicit hope that certain findings will be disseminated to the public. These talks can highlight scientists’ findings, however, this format tends to fall short of providing the material interpreters need to forge emotional and intellectual connections with visitors (Tilden 1957; Ham 2013). To increase the public’s awareness of park-based research, interpreters need background on studies, stories about the researchers, props or visuals to explain methods and challenges, and a plethora of ideas, metaphors, or analogies for establishing relevance. Without meaningful time for exchanges with interpreters, scientists miss out on opportunities to hear interpreters’ questions and observations formed as a result of daily observations of the resources. New models are needed which prioritize an exchange.
Interpreters are well-acquainted with the questions to which the public craves answers. The iSWOOP project is testing its model of PD that starts with interpreters’ and visitors’ questions, structures direct contact for interpreters and scientists during fieldwork and seminar-style interactions, and affords time together for meaning making.

Science communication is of vital importance because it seeks to inform decision making, but science is nuanced and complicated (Fischhoff 2013). Uncertainty is implicit in science, and grappling with this takes time and skill. The iSWOOP model allows scientists a powerful way to connect with the public via an extensive network of trustworthy informal educators in the National Parks System (Merson et al. Forthcoming 2018, this volume), eager to tell the story. We have provided interested readers with a Sample PD Outline and a Planning Worksheet to help them better connect with informal science educators (see Supplementary Material).

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Supplementary data
Supplementary data are available at ICB online.

References