Chapter 5
From Acquisition to Inquiry: Supporting Informal Educators Through Iterative Implementation of Practice

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One December day in Pittsburgh, the project team for museum/school collaboration gathered in the basement of the Carnegie Museum of Natural History to debrief a visit to the museum by Pittsburgh Public middle school students. The team included the science curriculum coordinator for Pittsburgh Public Schools, the newly appointed director of museum education, a new museum educational program designer, and three learning researchers from across the street at the University of Pittsburgh. The team also included eight seasoned museum docents. The docents were typical types for a natural history museum: They were mostly retirement age, well educated; they loved the museum, and had backgrounds in (or strong personal commitments to) science, nature, or education. They all wanted to give something back, to share their interest in the museum and its collections. But on that day, the docents were not in a good mood:

> Ninety percent of the problems—and there were problems—on the November 22 tour had to do with the audience. They simply were not there… I spent more time being distracted by getting them to listen and pulling them away from taking pictures… For God's sake don't let them bring cell phones. It is the single most destructive invention for education! (Steve,[1] 16 December 2011, meeting transcript)

The docents were talking about school trips they had developed using the existing museum practice of writing their own personalized tours around a small set of general, high-level objectives given to them by the museum. In this case, the objectives came directly from a federal grant that funded this project.

[1]All personal names are pseudonyms.

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Elizabeth agreed with Steve's assessment of the students: "They had an inability to focus" (Elizabeth, 16 December 2011, meeting transcript). Other docents agreed that the students were difficult to manage, and felt that their chaperones and teachers did not have disciplinary control over student behavior in a way that allowed the docents to feel comfortable. While the rest of the docents in the room nodded emphatically, Steve explained: "The teachers have to understand that it is not our role to impose discipline. I have a lot of trouble doing it. There has to be a clarification of what their role is before they get here, and they have to stick to it" (Steve, 16 December 2011, meeting transcript).

After about 15 min of listening to the docents air their frustrations, the school districts' science curriculum coordinator leaned forward in his chair and, in a quiet, reasonable voice, changed the whole direction of the project:

> You know, [pause] this is the student and teacher population that come to us in this public system. We should not orient our conversation in a direction that has us thinking about aspects that are not in our control. What is in our control is to make the tour as engaging as possible. If our students have electronic devices, then we should use them. To say that these students cannot focus is inaccurate, there is evidence that they do focus on things in their lives, but we need to meet them where they are and engage them in the type of learning that fits them (Tim, 16 December 2011, meeting transcript).

The Challenge of Professional Development for Part-Time Informal Educators

We ask a lot of museum educators. School trips are still the primary way that schools and museums interface, and for many students, the school trip may be the only time they visit the museum. Docents, tour guides, or museum educators are typically the only point of human contact between students, teachers, and the museum. Across all of the school trips in all of the museums in North America, this adds up to millions of contact hours per year with students.[2]

Yet, despite their central role as informal educators, museum docents face a number of difficult challenges and are often poorly supported in terms of professional development. Docents are often part time, usually untrained in contemporary science education pedagogy, and accustomed to a fair amount of autonomy in their work. If they had any formal training or experience as educators, it may well have taken place decades ago when knowledge-focused, teacher-centered didactic approaches were the norm. Many may have made their minds up about the nature of quality education long before people began advocating for inquiry or using mobile devices as tools for educational engagement (Grenier, 2005, 2006).

[2]There were approximately 55 million students attending public and private schools in the US in 2014 (NCES.ed.gov/fastfacts). If 10% go on museum trips, which typically last an hour, museum education will account for about 5.5 million student contact hours this year.

What do we know about how museum educators are prepared for this important role in our science education infrastructure? Docent training typically entails lectures from curators, readings, and shadowing more experienced docents (Abu-Shumays & Leinhardt, 2002; Castle, 2006; Grenier, 2005, 2009; Grenier & Sheckley, 2008). There is a common, yet paradoxical discrepancy between the participatory theories of learning espoused by docent trainers, who are usually full-time staff in a museum's education department, and the knowledge acquisition-based theories that docent trainers actually use in practice (Grenier, 2005). "Without training reflective of engaging programs that encourage questioning, interaction and experimentation, docents will likely continue to lead tours in a manner that mirrors their prior learning experiences in schools and in docent training" (Grenier, 2005, p. 6).

Prior research has demonstrated that for students on school trips, museum educators expect students to apply prior knowledge, make connections to real-world situations, and have a positive experience that sparks enthusiasm for learning in museum environments (Tran, 2006). These are quite different expectations when compared to those classroom teachers have for measurable improvement on exams or standardized tests, mastery of skills, and completion of curriculum-based instruction. Despite these distinct expectations and priorities for students, museum educators tend to utilize a limited set of strategies for engaging school-trip students, and as a result, their educational practice appears very similar to that of formal classroom teachers. Researchers argue that museum educators need to develop a shared professional language and museum-specific pedagogy to support the affective and student-centered learning objectives that museums are uniquely suited to serve (Allen & Crowley, 2014; Tran, 2006).

In this chapter, we describe a project that addressed the unique professional development needs of docents. The vignette that opened the chapter took place about a year into a NASA-funded school trip project at the museum, at a point when the leadership on this project had undergone a complete turnover, and new leaders were attempting to understand what was happening with the project and what was necessary to move it forward and ensure its success. Elsewhere, we describe the nature of docent change in more detail (Allen & Crowley, 2014). Here, we expand upon the processes our project followed to encourage docents to embrace an inquiry-centered approach to learning. For this work, we draw from transcripts of meetings with the docents, open-ended survey results from a brief written satisfaction survey conducted after a docent training, and the results of one-on-one, semi-structured interviews conducted with seven of the most active docents on the project. The first author conducted these interviews after the spring semester when the first round of new school trips were tested and implemented.

A New Approach to School Trips to the Natural History Museum

The vision for this project was that students on school trips would encounter the museum as a museum. Within a general frame, students would able to follow their own interests, seek out exhibits, interact and converse with each other, and document their own observations in ways that made sense to them. This vision for school trips contrasted sharply with the existing condition. Traditionally, docents led groups of approximately 10 students and one chaperone on a tour of various areas of the museum, while explaining different concepts related to the exhibits the docent decided for themselves that the group should visit. The docents felt comfortable with this format, because it allowed them to maintain control over the content and conversation that occurs during the tour. The format also fit with how they tended to conceptualize learning, as the transmission of information from the more knowledgeable expert to a less knowledgeable student (Allen & Crowley, 2014).

Traditionally, docents were accustomed to receiving in-depth content-laden lectures from relevant curator and perhaps reading several articles on science content to prepare to lead school trip groups. And this approach had been fine with the docents, who often view themselves as life-long learners in pursuit of facts and content. After all, many of them chose to get involved with the museum because they valued its collections and because it fit with their own personal identity and desire to be around others who connect deeply with museums and content. For example: "I've always been a museum person" (John, 13 June 2012, interview); "I've always loved museums and always wanted to be involved in archeology… I really like working with the people here. Overall, they're the kind of people I want to interact with" (Naomi, 12 June 2012, interview); "I have a degree in biology… and I've always loved the museum. I like the people." (Lucy, 13 June 2012, interview); "I've been coming here since I was a kid, I mean, this is the greatest place" (Clara, 15 June 2012, interview); "I wanted to continue learning new material, to be with an intellectually stimulating group of people and environment" (Steve, 13 June 2012, interview).

But as should be clear from our account of the December 16 meeting that opened this chapter, the business-as-usual approach was not sufficient for the docents to "meet the middle school students where they were," and was instead proving frustrating for both student and docent. We needed to come up with an alternative.

Iterative Implementation as Professional Development

We use the phrase "iterative implementation" to describe our process of reflectively working to actualize a newly designed educational program, or a program that is new to a particular context. Through iterative implementation, practitioners identify

something that is not working during a cycle of implementation, new ideas are discussed and tested, and, if more successful, are implemented into the next version of the program.

We see iterative implementation as part of the same family of research/practice approaches as design-based research (Barab & Squire, 2004), and design-based implementation research (Penuel, Fishman, Cheng, & Sabelli, 2011). Iterative implementation is different from these other development methods in that it is a less resource-intensive and more reflection-based process that facilitates professional development and successful program implementation in situations where institutional constraints may impede design processes that include practitioners in the role of full on co-designers. Rather, the leadership team conceived the learning principles and approaches of the new school trips, and the docents (who did not have the time to be full participants in that process) acted as beta testers, who had the authority to tinker and customize within the broad parameters of the new structure. This reflective process facilitated the development of the new, untested design into a program with which educators are familiar and believe in, because they have worked to see its successful implementation over time (see Nunnery, 1998 for an example from formal education). The most important part of iterative implementation is reflection and conversation among implementing educators: they must have opportunities to share successes and challenges from each iteration, while also sharing and vetting ideas and strategies for improvement to be tested in the next implementation.

The primary venue for reflection and conversation among the docents on this project was the debrief meetings held within a few days after each of the school trip implementations. The first author facilitated these meetings, encouraging docents to share specific examples from their recent school trips, and discussions of how to utilize successful strategies, and how those connected to the guiding principles for inquiry-based learning. The debrief meetings gave docents the opportunity to continue to share their experiences, both good and bad, with one another and with the leaders of the project, in an effort to make their work on the new school trips as successful as possible.

Guiding Principles for Inquiry-Based Learning

The new school trips were structured using three guiding principles for inquiry-based learning from learning science and educational psychology research: learner autonomy, conversation with reflection, and deep investigation. Throughout this report, we refer to "inquiry" as the incorporation of these three principles into learning experiences. These principles were not only useful in structuring docent-student interactions during the project, but also served as principles for the professional development and learning taking place among the docents throughout the process of iterative implementation. The project leadership intentionally provided opportunities for the docents to experience learner autonomy, conversation

with reflection, and deep investigation within the iterative implementation process. We strove to provide consistency between the learning experience docents were asked to provide and the type of learning leaders were asking docents to engage in themselves (see Grenier, 2005). Below we explain the background for the three guiding principles for learning, including how they applied to students on the school trip and to docents in their process of professional development through iterative implementation.

Learner Autonomy

The principle of learner autonomy is important for motivation for learning and engagement (Ames, 1992; Linnenbrink, 2007; Pekrun & Linnenbrink-Garcia, 2010; Ryan & Deci, 2000), particularly in informal and museum settings (e.g. Barton & Tan, 2010; Falk & Dierking, 2000). Inquiry-based learning hinges on learner autonomy, positioning the learner as the decision-maker and encouraging learner-centered choices on the part of the teacher, facilitator, or (in this case) docent. By highlighting learner autonomy as a guiding principle in this project, we hoped to encourage docents to foreground learner-centered pedagogical choices, leveraging the advantages of free-choice learning provided by the museum. In contrast, the structure of traditional docent tours provided little opportunity for learner autonomy, and based on docents' reaction to student behavior at the first project meeting, we found it likely that middle school students would benefit from more autonomy, and that docents would benefit from thinking of autonomy as an important support for learning, rather than a detriment (Allen & Crowley, 2014). Early in the project, docents pushed hard against the idea of giving students autonomy on the museum floor. For example, after the second training session in mid-March, Elizabeth wrote on the open-ended survey: "Perhaps my issue with this is the autonomy idea. I can effectively guide an entire tour group through exploration to collectively learn" (Elizabeth, 18 March 2012, survey). However, by the end of the project, she was able to acknowledge that there was some benefit to allowing more autonomy to students at the museum, saying in an interview:

> Through my struggles with this [I] have found… I'm even looser with the way I do a tour. But guided and allow them to come up with their own conclusions, with a proper answer though… allowing for more observation, more conversation—I'm finding a lot of success with that because if your children are really excited, they go to an exhibit and they start chattering, that's your avenue (Elizabeth, 14 June 2012, interview; also quoted in Allen & Crowley, 2014).

The process of iterative implementation also provided autonomy to each of the docents as they implemented the new school trip design. Docents were charged with identifying where and how they would model the observation and analysis technique that students were asked to learn and document. Additionally, the docents were in charge of their own learning around the driving content questions and

learning objectives for the school trip, and would share articles with one another over email and have informal discussions about how to address content-related questions and ideas before and after school trip implementations, unfacilitated and unprovoked by the project leadership team. Having autonomy in their work at the museum was something that docents identified as valuable: "One of the things that attracted me to the museum is the autonomy, really. There's lots of stuff, support, and things to learn here, but when it comes to how you do it, you can pretty much do what you want to do" (Lucy, 14 June 2012, interview).

Conversation with Reflection

Conversation and reflection are important complementary learning behaviors that lead to deeper engagement and are often described as foundational in studies of museum learning (Ash, 2004; Barron, 2003; Crowley, Callanan, Jipson, Galco, Topping, & Shrager, 2001; Leinhardt, Crowley, & Knutson, 2002; Palmquist, & Crowley, 2007; Pierroux, 2010). Students were already engaging in conversation with one another, albeit it to the earlier chagrin of docents. As dual principles for inquiry, conversation and reflection were important in providing docents tangible scaffolds for students' learning experiences through their natural exploratory behaviors, such as asking questions, making observations, and talking with classmates (Allen & Crowley, 2014).

Conversation and reflection were the two most important aspects of docents' professional development through the process of iteratively implementing this new program. The main way that docents generated new ideas and strategies for successive iterations of the school trip were through the facilitated debreif meetings after each implementation, where docents would meet with one another and at least one member of the leadership team to discuss the successes and challenges of the most recent school trip. Steve found the debreif meetings to be essential to his and his colleagues' development:

> I think the debriefings after each tour were absolutely invaluable… when a docent begins to have an individual approach within the framework that has been established, that is a very, very positive sign (Steve, 13 June 2012, interview; as quoted in Allen & Crowley, 2014, p. 93).

In these conversations, docents learned from each other's successes and struggles, and were given the opportunity to spend time reflecting on their own experience with their colleagues, receiving feedback, and often learning that collectively they were experiencing the same challenges. These realizations enabled docents to more readily work together to come up with new ideas for how to address challenges in future implementations.

Deep Investigation of a Few Concepts

Finally, deep investigation of a few concepts, as opposed to shallow exposure to many facts, was our third principle for inquiry-based learning. This principle was targeted to help docents and teachers from feeling pressure to make sure students "see as much as possible", a common challenge for facilitators of museum learning experiences (Bitgood, 1989; DeWitt & Storksdieck, 2008; Kisiel, 2005a, 2005b; Orion & Hofstein, 1994). For students, deep investigation meant the opportunity to engage with an area of the museum in a way that allowed time and space to ask questions, record observations, have discussions, and re-visit ideas and exhibits without pressure to see everything (Allen & Crowley, 2014).

For docents, deep investigation was the opportunity to continuously engage around and improve a program being implemented for a large number of students over the course of a semester. This meant that they had the opportunity to try variations on the same design, tweaking their strategies based on what they learned in prior implementations. This is similar to a practice in formal teacher development called 'lesson study' (Hiebert & Stigler, 2000). Museum school trip programs are an ideal opportunity for informal educators to engage in deep investigation of a single program, because museums usually offer a small number of programs to schools for trips, and those programs are utilized many times over the course of an informal educator's tenure at the museum. By intentionally providing the space and time for group reflection during debrief meetings as part of the iterative implementation of this project, docents were able to deeply investigate how this new school trip worked, was improved, and how it could inform all of their work at the museum.

The Leadership Team and the Core Objectives

We, the authors of this chapter, were two of the learning scientists at the December 16 meeting. The first author was one of the primary leaders of the new school trip leadership team, along with Roselyn, the museum's education director, who was trained in youth development in learning, Tim the school district's science curriculum coordinator, trained originally as a physicist, and Jordan, the new program developer, who trained as a paleobotanist. At the conclusion of the December 16 meeting, the leadership team made a commitment to re-think the format of the NASA-funded school trips in light of the experiences the docents had shared and with the goal of capitalizing on the learning behaviors that the students were already engaging in at the museum (such as taking photographs). We made 'meeting the students where they are' a priority for the new school trip design.

Roselyn was brought on by the Carnegie's then newly hired director when the project was already under way. One of her priorities was to increase interactive and inquiry-based experiences on the floor. She pushed for more opportunities for

visitors to engage with hands-on natural history objects, and for more thought-provoking exhibits that would encourage conversations between visitors and museum education staff.

Tim, the science curriculum coordinator for Pittsburgh Public Schools, made it clear that the school trips provided by this project should prioritize students' opportunities to engage with real science. In this case, the NASA-funded project was for creating experiences that integrated satellite data and authentic objects from natural history collections. He emphasized that students do not have the chance to do engage with real scientific data and authentic objects from natural history collections in their classrooms, and that this school trip could potentially be students' only opportunity the entire school year to have a non-classroom style science experience. In particular, learner autonomy was an important aspect of these school trips for Tim: "Put a protective boundary around students if they are really pursuing their interests, that should be a priority. Don't pull them away if they are engaged. How can you protect that time and space?" (Tim, 29 March 2012, debrief meeting transcript).

The first and second author served a dual role as advisors to the project, recommending principles and ideas from learning research, suggesting new approaches, and helping to collect evidence to document impact. Bringing learning research to the table helped to legitimize the new pedagogical structures that docents were asked to implement during the project, important for docents who were initially skeptical about the emphasis on pedagogy and inquiry in the project's objectives and training sessions.

Finally, Jordan, a recent hire in the education department, served on the leadership team designing and implementing both the new school trip and the in-class session that preceded each school trip. The docents trusted Jordan because of her graduate training in paleobotany and her commitment to rigorous science content. Jordan, Roselyn, Tim, and the first author were the main developers of the new school trip structure that docents iteratively implemented between January and May of 2012.

The leadership team worked to generate a clear set of driving questions and learning objectives that would give the docents, teachers, and students a clear understanding of the learning expected on their school trips. These learning objectives, presented in Table 5.1, were designed to fit the same format as the curriculum and standards used by Pittsburgh Public School science teachers, allowing teachers to see the value of trips for their students, and allowing docents to connect with teachers immediately and easily regarding the goals of the trip in a format that made sense to both docents and teachers.

The new design for school trips for this project was grounded in the three guiding principles for inquiry-based learning (learner autonomy, conversation with reflection, and deep investigation). In addition, the original project grant stipulated that these school trips would include a classroom visit from a science educator from the museum, usually Jordan. Prior research on school trips has revealed that the more closely connected classroom learning and museum learning are, the better students perform on assessments in either venue (Gennaro, 1981; Orion & Hofstein,

Table 5.1 Driving questions and learning objectives

Driving questions		*Learning objectives*	
How are climate and biomes connected and what happens when they change?	Knowledge I can describe in my own words	Skills I can	Disposition & Participation I will
What are biomes?	Earth's biomes, using features such as precipitation, temperature, and vegetation	Utilize NASA data to identify and describe different biomes	Explore weather, climate, and biome data based on my own interests
What's the difference between climate and weather?	The differences and connections between weather, climate, and climate change	Identify and use scientific evidence (maps, fossils, photographs, etc.) to describe current and past climate change	Have conversations about biomes, climate change, observations and evidence with peers and adults
Do climate and biomes really change?			
How will humans respond?	Why it is important for people to understand climate science.	Ask questions and connect experiences to my own life.	Identify the parts of my school trip that are of personal interest to me.
How do scientists study change?	How my school trip site is part of climate science research and education	Access scientific evidence and learn through authentic objects, data, and living collections on my school trip	Recognize my school trip destination as a valuable part of my city—a place where I can visit, learn, have fun, volunteer, and find a job
What does NASA have to do with this?			

1994; Sturm & Bogner, 2010). Even though docents did not conduct the in-school visits, they were able to know what students had experienced in their classrooms immediately prior to visiting the museum, which was never the case for traditional school trip tours. The in-school visit introduced students to the main driving questions and learning objectives using hands-on activities with the two main tools students would also use while at the museum: a field notebook for recording observations, and NASA satellite data maps depicting the different biomes of the earth (Allen & Crowley, 2014).

On the museum floor, instead of leading groups to exhibits of the docents' choosing, as in traditional tours, docents were asked to direct the students on "expeditions" to two or three areas of the museum, where students would use the tools that had been introduced in their in-school portion of the program to engage with the exhibits on their own, punctuated by opportunities to ask questions and engage in conversation with docents and other students. Scaffolded opportunities for students to experience each of the guiding principles were described as follows: learner autonomy meant students had opportunities to choose which exhibits they would observe and how they would document those observations, e.g., they might choose to draw what they saw in an exhibit or use a mobile device to take a photograph. Conversation with reflection opportunities were encouraged by docents throughout students' visit to the museum in the form of questions and answers as

well as more open-ended opportunities to engage in conversations with peers and teachers. Each school trip ended with a reflective conversation where students discussed their favorite exhibits in the museum and how they connected biomes to climate. Finally, deep investigation meant that docents and students would stay in one or two areas of the museum to engage with them for more time, rather than rushing through to try to see more of the museum, even though it meant some students did not see all the exhibits.

Inside Iterative Implementation

The leadership team introduced the iterative implementation process, guiding principles for inquiry-based learning, and new school trip structure to the docents in a classroom-based training on January 26, 2012. That training included, at the docents' request, a lecture on climate science, and a long discussion about how to talk about climate change while 'avoiding controversy'. The questions and concerns voiced by the docents at this training mainly focused on their discomfort with the topic of climate change, and logistical concerns regarding the new structure and how to coordinate timing the new activities. The first training presented the docents with a great deal of information, and asked them to implement the new structure the following week.

The first school trip implementation of the new structure took place on February 2, 2012. Nearly 200 students from one of the district's largest middle schools attended the school trip, and approximately 12 docents were involved in two 'rounds' of the school trip. This first school trip included several unexpected logistical demands—the first author ended up helping several groups who had been separated from their docents to find them on the floor of the museum, and locating missing equipment (e.g. clip boards and pencils for students and chaperones). During this trip, we observed that docents were not confident in the new structure they had been presented with the week before in training, and in the midst of a crowded and chaotic day at the museum, they fell back on the traditional structure of the docent-led tour, where the docent did the majority of the talking. Students were observed to be mostly compliant but not highly engaged with the content of the docents' lectures (see Fig. 5.1).

At the first debrief meeting of our new school trip season, the discussion predictably focused on logistics and smoothing out the rougher edges of our first attempt to implement the new structure. In particular, docents needed to have more information about where the different stations would be located on the museum floor—they wanted to make sure they could bring their groups to the touchable objects and data exploration stations within the tight time frame of a 90-minute visit to the museum, and feel that they had covered the driving questions and learning objectives that had been established for these school trips.

Fig. 5.1 Students on the early February school trip to Carnegie Museum of Natural History sit and listen (or not) as a docent as she gives a lecture in front of a bear

In this first debrief meeting, the docents began to realize that they had experienced autonomy on the floor in the museum, and that it was something valuable to their work:

> Mary: Are you going to tell us that we have to go from here to here and then here?
>
> Lauren: Do you want that?
>
> Mary: NO!
>
> Lauren: I think we want you to have a set of examples of how climate and biomes interact that you're really comfortable talking about with students (8 February 2012, debrief meeting transcript).

The docents were not yet comfortable implementing the new structure for these school trips, but they were also not ready to give up on the idea of making changes in their practice to ensure that students were engaged and reaching the learning objectives that had been agreed upon by the museum and the school district.

After the initial school trip implementation, the leadership team met to re-group and assess the finding that docents had not fully understood what the new structure could or should look like on the museum floor. We planned an 'on-the-floor' training for docents, which included the full 45-minute in-school session in a classroom in the museum, so that they could experience what their students would have in school within a few days before coming to the museum. The docents resisted putting themselves in the role of the student during this training, but afterwards provided mostly positive feedback on the training experience, citing conversations with other docents during the training and being able to talk about examples on the floor as very valuable.

Following this training, the first author distributed a survey asking for docents' feedback on the training format and content, and their overall enthusiasm for the new school trip structure. The survey responses indicated that many of the docents were still very much focused on 'knowing more facts' as a result of their training, and put pedagogical training at a much lower priority, for example: "While pedagogical theories about learning are interesting, docents need to continue to be trained on scientific facts and recent findings" (Marco, 19 March 2012, survey). Since we had only engaged in one school trip/debrief meeting cycle, after this training, docents had not yet had a chance to see how their subsequent implementations of the new structure might change over time. However, one docent indicated that she understood these particular school trips would evolve and depend on the students who attended them: "I think this will be a tour that is constantly revising itself especially dependent on the school groups we get" (Joanna, 19 March 2012, survey).

Over the course of five more iterations of the school trip and follow-up debriefs, docents discussed their experiences, what they would like to see change and what went well for them, and how they would adjust their strategies next time around. Their concerns moved from almost entirely about logistics and coordination to deeper questions about student learning and strategies for engaging students in the new school trip structure. Once they realized that they had some control over how they iterated and tried new ideas after discussing them in debrief meetings, they became enthusiastic about debriefing and reflecting on their own processes. For example, Steve noted in one debrief that the structural changes were not something that came easily to him and his colleagues: "There is a lack of comfort with the different format, so if folks are also uncomfortable with the content, they fall back onto their more comfortable format of lectures—this is how we were trained" (Steve, 29 March 2012, debrief meeting transcript).

When students responded positively and engaged readily with the new format, docents were able to see that what they were implementing was working. The docents began to recognize and value the three guiding principles for inquiry-based learning. Autonomy became very important: "the students respond well to having free time on the floor, this format works better than regular tours" (Paul, 29 March 2012, debrief meeting transcript). As well as conversation and deep investigation: "There were really dynamic questions from students, when they get interested and have time to engage, there was lots of conversation. Docents shouldn't whisk students away if they are engaged, it breaks down the good conversations that are beginning" (Steve, 29 March 2012, debrief meeting transcript).

Towards the end of the iterative process, the docents collectively came to the conclusion that they were improving in their work. Docents at first attributed the improvement in students' behavior and engagement to a higher level of student preparation. The project's leadership team encouraged the docents to think about themselves as learners and consider the possibility that they could be the ones improving in preparedness:

Lucy: These field trips have been really interesting and different every time. This most recent group was the best group, most fun and engaging students so far.

Paul: These tours have been successful because the students are very well prepared, both with their knowledge and willingness to be engaged.

Jordan: How well prepared the students are varies from school to school. Could it be that the conversational aspect of these field trips is why we are observing these successes?

Steve: The kids are better and better every time we do these trips. Something is changing that's making the trips better and better.

Roselyn: Do you think that you docents might actually be getting better and that's why it feels like the trips and students are getting better and better?

Aaron: These debriefings that we do after every trip help us docents to improve our 'product' (7 May 2012, debrief meeting transcript).

This exchange was followed by a flurry of exclamations around the room. The general sentiment was a realization that the hard work of trying new things and reflecting on them regularly could pay off in a tangible way. The iterative implementation process helped docents to grapple with logistics early on and later become comfortable with a new way of working with students. After several iterations, they began to spontaneously engage in sophisticated examinations of what learning really is, and how it can take place in the museum:

Lucy: I don't know if the students learned much on this trip.

Lauren: What do you mean by "learned much"?

Lucy: I don't know if they left with some new information in their heads about climate change.

Steve: We can reinforce things that they already know, that is also learning.

Lucy: I would not include that in my definition of learning.

Andy: The teacher might give a verbal definition of a biome that students can regurgitate, but it might not be meaningful. Coming to the museum and seeing the biomes helps them understand what biomes are in a real context, and how that information is useful.

Lucy: I still see a distinction between affirming something that's already known and getting new information.

Lauren: Maybe we can think of it as students learning the skill of using their knowledge.

Roselyn: Learning is reflexive, people are always revisiting what they learn. Coming to the museum is rich and emotional for kids, this is a good opportunity for learning because affective experiences lead to stronger memories.

Steve: Here they can see and touch and make more enduring memories (7 May 2012, debrief meeting transcript).

In this conversation, Lucy was questioning whether the project team, docents included, were really justified in their excitement about the more recent iterations of the school trips, which had been deemed very successful in debrief meetings. She challenged her colleagues about the definition of learning, and project leaders as well as her fellow docents bring up different kinds of learning and how the museum

is an important venue for them. Compared to their earlier insistence that learning can only be the transfer of 'factual knowledge' from one person to another, this conversation is a big step toward embracing the types of learning in informal environments that have been identified as valuable by the field (Bell, Lewenstein, Shouse, & Feder, 2009).

By the end of the iterative implementation period, the docents recognized that they had made iterative changes in their educational practice on an individual level: "Every time I worked on a tour [for this project] I did it a little bit differently" (Lucy, 14 June 2012, interview);

> …as I went through with the next group and saw where they were stumbling, I knew which questions to ask the second time around to make it easier for them to get what I wanted them to get out of the exhibits… I've learned something with each particular group (John, 13 June 2012, interview).

In addition to these individual iterative changes, the docents had begun to develop into a community of practice (Wenger, 1998) around implementing the new inquiry-based principles for learning, and reflected on their changes as a community:

> The debriefings after each tour were absolutely invaluable. You could see what was working… I could sense that we were getting more comfortable with the idea that we were getting better at it… When the docent begins to have an individual approach within the framework that has been established, that is a very, very positive sign (Steve, 13 June 2012, interview).

Steve, like other docents, had been particularly skeptical and resistant to the new school trip format early in the project's trajectory, but as we reported in Allen and Crowley (2014), he became one of the project's strongest advocates, even using the inquiry principles to re-create one of the museum's most popular docent-led tours into a more inquiry-based exploration. Several other docents agreed that the new format was valuable, even though the change was not intuitive or easy for them or their colleagues:

> In the initial training, I was skeptical as to how this was going to work. I thought, oh I don't know. I'm not used to doing tours in this manner where there's so much freedom to explore. I thought I would lose control, but I was really surprised that given the opportunity, it works really well… we need to update the way we do [all the] field trips… I think the docents can be flexible. We're all not young so sometimes it takes a little arm-twisting to get things to change. But change is important and that's what life is all about (Naomi, 13 June 2012, interview).

In a similar vein, Clara recounted how she shared her feelings about the project's value with a colleague:

> I was just saying to another docent the other day, there were things that came out of our training that we will use. You might not realize you're using it because you did it on the NASA trips, but I think you do… there was a lot of learning for everybody that came out of it, I think (Clara, 15 June 2012, interview).

The process of iterative implementation helped the docents to see that change was possible, and not necessarily a negative aspect of their work:

> I was surprised at how much it [the trip] changed… each time out it was like, okay, we're going to do this. The [field] notebook changed. The stations changed. So I did like that about it, that it was actually changing as we did it… I don't think the end result was where everybody wanted it to be, but it was heading in that direction. And I think people listened to each other a lot. When the transition came, the docents were defensive about the whole thing, some of those changes made the docents feel threatened, but then the docents came around, we were like, we shouldn't feel threatened, we should contribute. Everybody worked together (Clara, 15 June 2012, interview).

Conclusions

The docents at the Carnegie Museum of Natural History progressed in their ideas and opinions about the students from Pittsburgh Public middle schools, which we documented in the opening vignette of this chapter. By the end of the iterative implementation process, even though the students they were working with were simply a few months further along as seventh graders, the docents' perception of them was entirely different. The project leadership team provoked the docents into considering that the new school trip approach could have something to do with how much more successful their school trips were.

The iterative implementation process allowed the docents to grow and develop professionally in facilitating an inquiry-based school trip program. Iterative implementation also provided a streamlined process for taking an untested school trip design and turning it into a program that educators and docents were comfortable offering. Many of the details of the new school trips were dictated by the grant that funded the project. However, the docents and educators decided to offer the new school trips not only to the students who were covered by the grant, but also as one of the available programs offered to schools from other districts that come for museum visits. The grant did not provide an abundance of funds for staff development on the new school trips, but the new format required that docents be supported as they learned how to engage students in the inquiry-based process. We found that by encouraging reflection and providing the space of the debrief meeting after each school trip in the first six months of the new structure's implementation, which used relatively few resources but provided an important space for professional interaction and conversation through which docents grew and developed their practice.

This project required us to address the question of how we would get the docents to implement a new school trip design about which they were initially very skeptical. In the case of this project, not only was the inquiry-based pedagogy challenging, but the content area of the school trips was also something around which the docents had experienced discomfort and conflict—in part because not all of the docents had the same opinions about climate change.

The new design and content of this project set us on a course of disrupting the existing system of docent-led and docent-centered tours. Although the docents were resistant to the new pedagogy and the challenging content, iterative implementation provided space to have a conversation with project leadership and one another. The iterative implementation process allowed docents to maintain autonomy in their practice, and deeply investigate the new school trip design. By providing the space for docents to reflect together as a regular part of their process, they were able to collectively develop their understanding of learning from one strongly focused on acquisition to one that more clearly articulated and acknowledged the value of inquiry.

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