Reflecting on Practice Through Action Research: The Zoo and Aquarium Action

Research Collaborative

James Kisiel, Andee Rubin, Tracey Wright

Background

The Zoo and Aquarium Action Research Collaborative (ZAARC) was an NSF-funded

project (DRL-1114335) involving four zoos and two aquariums, plus informal science

education researchers from TERC (a non-profit educational research and development

company in Cambridge, MA), Oregon State University and California State University,

Long Beach. The goal of ZAARC was to investigate how action research might be

carried out by educators in zoos and aquariums, and how its implementation would

impact both the individual practitioners and their institutions.

Action research was used in ZAARC as a form of professional development that

empowers educators to study and analyze their own practice, guided by questions that

arise from everyday events and dilemmas. The ultimate goal of action research is to

improve practice, as action researchers construct their own questions based on what they

know best – their own practice. (Reason and Bradbury, 2006; Ballenger, 1999;

Ballenger, 2009). The ZAARC project chose action research as the basis for its

professional development based upon several strengths of this approach to changing

practice through reflection. For example:

- Theories and knowledge are generated from research grounded in the realities of

   educational practice.

- Practitioners investigate their own problems and are more likely to facilitate

   change based on the knowledge they develop.

- Because practitioners can choose research based on specific institutional

   circumstances, the opportunity for synergy between practitioners' interests and

   institutional priorities is built into the model.

Goals

The primary goal of ZAARC was to support zoo and aquarium educators'

development in three areas of their practice. Our implicit hypothesis was that these

changes would, in turn, create better experiences for visitors at their institutions.

- **Taking an "action research" perspective:** Our goal was that participants would

   adopt an inquiring stance toward their own practice, be curious about how they

   might improve what they do, and be willing to investigate the effects of changes

   they decided to carry out.   This stance also includes comfort with the use of tools

   to document visitors' and staffs' actions and a commitment to the value of

   evidence in considering and assessing change.

- **Focusing more intentionally on visitor engagement:** A focus on defining evidence of visitor engagement emerged early in the project from participants' interests. For many participants, this meant developing a shared language to describe visitor experience and appreciating the value of carefully observing visitors rather than immediately interacting with them. Equally important, it also required participants to think in terms of desired visitor outcomes, rather than staff actions.

- **Increasing their sense of professionalism:** We hoped that participants would come to see themselves as members of an intellectual community and a profession with a research literature and that they would, by the end of the project, have an increased sense of their ability to make a difference in the field.

The Model

ZAARC developed and implemented a model of Mentored Team Action Research. The "team" aspect of the model describes the fact that participants worked in groups of two to four from each of six institutions: Aquarium of the Pacific, Maryland Zoo, New England Aquarium, Phoenix Zoo, Saint Louis Zoo and Woodland Park Zoo. We believed that a group of participants would be more likely to find the time and resources to carry out an action research project than an individual would, would encourage and support one another when the work inevitably got difficult, and would provide a natural context for the kind of reflective discussions of evidence that are a critical part of action research.

We realized from the beginning that taking on an action research project would be a significant commitment for ZAARC participants and that they would need mentoring from people who had experience in research and development in informal learning environments. We originally assigned a single mentor to each team, but after the first year decided that using pairs of mentors worked better, as each mentor brought a different and complementary perspective to the discussion. ZAARC mentors were: Andee Rubin (Co-PI of ZAARC) and Tracey Wright from TERC, John Falk (Co-PI of ZAARC) and Lynn Dierking from Oregon State University[1] and Jim Kisiel from California State University, Long Beach.

The ZAARC process took place over a period of three years, shown graphically below. The experience began with the first of two Project Institutes, held at the New England Aquarium (NEAq) in Boston in early 2012 and attended by all ZAARC participants and mentors. At that meeting, participants were introduced to the concept of action research, watched and analyzed videos of visitors to informal learning environments, observed visitors at NEAq and engaged in the *Be An Animal Scientist* activity, in which observers track and record animal behavior. In a discussion at the end of that meeting, the group identified "identifying and measuring visitor engagement" as a topic of mutual interest on which the project would focus over the coming two years.

---

[1] Julie Haun-Frank of Oregon State was a mentor for the first year of the project.

INSERT FIGURE 6.1 HERE

After the Institute, participants engaged in a first cycle of action research, dubbed their

Phase 1 project. In order to provide everyone with a similar experience, to support

participants' investigating visitor engagement and to foster the growth of a community of

researchers, each team was to conduct the same activity, *Be an Animal Scientist*, at their

site, and observe visitors carefully in the process, including videotaping a selection of

visitors. The activity involved visitors' observing, counting, and categorizing behaviors

of animals. Each site chose its own species and setting for the activity. It is worth noting

that although the Phase I project targeted an aspect of practice that was important to

participants from all sites, it was designed more as an introduction to the research

process, rather than a true action research project which would be more closely shaped by

questions that arise from specific practices.

In preparation for this first research experience, each team had to complete an

Institutional Review Board application for protection of human subjects. There were also

a series of monthly assignments, including reading research articles, watching videos, and

structured observations of visitors. Each team met monthly with their mentor by phone

or Skype to discuss the assignments and progress on their Phase 1 project. During this

first year, each team also considered what they would take on as their Phase 2 Project,

which was to be an action research topic of their choosing. In the summer of 2012, each

mentor visited his or her sites, in order to get to know their local institutional context, and to watch and discuss videos of their *Be An Animal Scientist* implementation.

The second ZAARC Institute took place in early 2013 at the Aquarium of the Pacific in Long Beach, California. The meeting represented the end of Phase 1 and the beginning of Phase 2. Prior to the meeting, ZAARC staff prepared a DVD with each site's report on their *Be An Animal Scientist* research, including a selection from their videos of visitors. Participants received and reviewed the DVD prior to the meeting, so that they could have more in-depth conversations about their Phase 1 experiences at the Institute. At the meeting each team also described their nascent plans for a Phase 2 Project. Other participants, mentors and project advisors offered comments and suggestions on these plans, and several Phase 2 projects changed significantly as a result of the discussions at the Institute. Action research plans identified by participants for Phase 2 included:

- To what extent do visitors who participate in educational programs use the information provided during their subsequent on-grounds experience?

- How are visitor engagement levels at a live animal exhibit affected by participating in a behavior observation activity?

- How can we characterize and measure successful engagement in our school programs?

● How will interpretive training and structured reflection time affect front-line interpretive staff and volunteers' perceptions of their role as interpreters?

● How do modifications to a curricular unit support students' understanding of the process of creating a testable investigation question from their observations?

● Where and when did young children visiting a nature-based playspace show engagement and empathy behaviors?

● How can we create a culture of more reflective behavior among staff?

This wide array of research questions reflects the different needs of each institution. It also demonstrates how the examination of practice through a lens of learner engagement, introduced in Phase 1, was incorporated into the individual projects.

During the next year of the project, each site was primarily involved in carrying out its Phase 2 action research project, aided by monthly meetings with its mentors. The project provided support to teams in their research process by distributing articles on choosing a research question and approaches to qualitative data analysis. Mentors were able to provide more specific help, often by recommending related literature or observation tools that had been developed by other researchers. Mentors' site visits in the second year

focused on collaboratively analyzing the data participants had collected and considering what might be learned from them.

Each team wrote a research report on its Phase 2 project(s), following a format the project provided. These were distributed to the rest of the ZAARC participants and will be published as a book through Amazon in 2016. The ZAARC project was also presented during the Association of Zoos and Aquariums conference, the Visitor Studies Association conference and several local museum conferences in 2014.

During Phase 2, participants kept in touch through a series of three project-wide Google hangouts to share their methods and findings and to get help from other sites as challenges arose. We had hoped to have a third Institute (as had participants) during which participants could report their research process and findings to the rest of the ZAARC community, but were unable to obtain funding for that meeting, so the project's last gathering was virtual rather than face to face.

Data

Since ZAARC was both a professional development project and a research project, we collected a considerable amount of data on participants' experiences. In addition to video records of both Institutes and extensive field notes by mentors documenting both their monthly meetings and their site visits, we had several more formal data collection efforts.

In addition to the actual Phase 1 and Phase 2 research reports, we collected an individual reflection on the process from each of the ZAARC participants. The ZAARC evaluator, Cynthia Char of Char Associates, administered online surveys after each Institute and at the end of the project; she had also interviewed an administrator at each participating institution at the beginning of the project. Mentors interviewed each of the participants at their sites over the phone at the beginning of the project. Most relevant to the results reported here was a structured phone interview with each of the 18 individual project participants conducted at the end of the project. All quotes included below are from those 30 – 40 minute interviews.

Successes

Utility of Action Research

Although most of the practitioners were unfamiliar with the idea of action research at the start of the project, a much clearer sense of both the concept and its value to zoo and aquarium professionals had clearly emerged by the culmination of ZAARC.

When asked how action research might be helpful to their colleagues in zoos and aquariums, the educators participating in action research provided a variety of perspectives. Several commented on how *the process helped them to define or achieve their mission,* as it became necessary to revisit objectives and goals when considering

9

which observable or measureable outcomes might count as evidence for various

constituencies. For example, some noted that the process would be useful for

communicating with administration and funding agencies as they were able to provide

more tangible information about the impacts of their programs. Educators also

mentioned how the process of gathering and using evidence was empowering, allowing

for more informed and confident decision-making.

> *I feel like I learned a really easy, structured way that I can strategically improve*
>
> *my practice to improve what I do, and improve the programs that I do—whether*
>
> *they are for other educators, or for students…that I can utilize forever.*

Several educators remarked how *the research process was an important part of*

professionalizing the field of informal education. This came both from understanding the

importance of evidence for directing practice, as well as a recognition that others

(researchers, educators, etc.) were also studying and even reporting on some of the same

issues that these participants were experiencing in their own practice.

> *I walked away with … this understanding that there was a lot more research and*
>
> *kind of a more formalized framework that I could build off of as an informal*
>
> *educator than I ever imagined possible.… I had no clue that it was as big as it*
>
> *was, and comprehensive across the planet, you know, people working in museums*
>
> *or zoos or whatever in Europe and all over the US, and all these studies and such.*

10

This newly discovered connection to the field provided additional validation for some—validation to their peers in zoos and aquariums, but also validation within the larger education community.

As these educators advocated for the use of action research, the importance of reflection became very apparent to them. Participants spoke of how their experiences with action research allowed them to create the opportunity to reflect on their own practice—something they rarely had time (or even intention) to do. Some even defined action research as a reflective tool or process of reflection. By virtue of identifying a problem or question, collecting relevant data, and then making sense of that data, these educators found themselves thinking about and questioning their current practice.

> *I think this project gave me access and avenues and time to both read articles and kind of reflect on our programs in a new light, but also reflect on our programs with other people with a shared language, which has been very helpful.*

Developing Identities

One of the primary aims of the ZAARC project's research component was to understand how involvement in a shared action research experience would affect participants. Given the importance of having the opportunity to think more deeply about what they did and

how they might define success, it is perhaps not surprising that ZAARC led to different aspects of identity development, (i.e. different ways of seeing themselves as educators or professionals) for this group of practitioners.

As mentioned above, these educators unanimously recognized the value of action research as a tool to improve their practice. They commented on the different techniques they had used, both for data collection and analysis, that would help provide evidence related to their work. These ranged from the application of visitor observation protocols to the development of specific training efforts aimed at engaging staff as learners. The process led to what the participants identified as *development as a professional* zoo and aquarium educator.   The awareness of research studies and a literature related to learning in informal settings, the broader perspectives on visitor behaviors and motivations, and a renewed urgency for effective staff training all grew as a function of their experiences within ZAARC.

With this renewed (or even new) sense of professionalism came a newfound *confidence in their role as researchers*. By the end of the project, many felt that action research was now something that they could actually *do*, not just read about or discuss. They had gained a new means for understanding and improving their practice, and now saw themselves as having developed some expertise in its use.

> *We tend to do a lot of this work just from a gut perspective or a gut instinct when we sort of evaluate or assess our program. And so having a better understanding of action research, I think, validates that process more and can formalize what it is that we do, which as B. said at the end of our ZAARC presentation at AZA that it helps to professionalize our field a bit.*

Another impact reported by the ZAARC educators was a sense of their *increased value to the institution*.   For some participants, a recognition of the importance of their role within the institution emerged, coupled with a sense that their efforts had great potential to contribute to the organization's mission. Others reported that their efforts changed their 'status' within their institution. These educators felt that colleagues in other departments were now more aware of their talents and contributions, elevating their role in a way that could lead to a deeper participation in decision-making within the institution.

> *I don't know if it changed how I saw myself, but I can tell you it changed how a lot of other people saw me. I knew I could do this stuff, like that's not surprising to me … I now have people asking me for help on stuff that I would never have had probably asked me for help before.*

The perception of change in status within the larger community of their zoo or aquarium, especially if they previously felt that they had no voice, can play a critical part in an

educator's intrinsic motivation and desire to continue to learn and develop as a

professional.

Over the course of the multi-year project, more than 50% of the participating educators

had changed positions or been promoted. When asked whether ZAARC contributed to

these transitions, none of the educators credited their participation in the project as an

exclusive factor. Several mentioned how their work with ZAARC may have helped

make them a more viable candidate for the new position or made others more aware of

their skills. However, most felt that the promotion was just a part of their progression at

the institution, and was indicative of past good work.

It would seem then that the activities of the ZAARC project were frequently intertwined

with shifts in responsibilities and roles, although changes in responsibilities over the

course of the project might be attributed to their selection for participation in the first

place. When asked to assemble a team of educators to work on a research project, it

seems reasonable to assume that supervisors and administrators would select those who

seemed to have the potential for growth.

Of course, professional transitions are ideally a part of practice. For some of the

promoted educators, the ZAARC project provided a mechanism for thinking about the

expanded responsibilities associated with their new positions. For others, though, the

change in position became disconnected from the action research activities. In those

cases, the educators were perhaps moved to a new department for which the practice-oriented research was no longer directly applicable. In some cases, the transition resulted in a supervisory position. Several of these educators admitted that they were unsure as to whether they still considered themselves "educators," given that they no longer worked directly with visitors. These different responses remind us how closely focused these educators are on their current practice, and about the importance of action research as a tool specific to improving practice that is clearly and immediately relevant to the educator.

New Tools and Practices

In addition to the benefit of participants' developing new perspectives on their practice, a variety of new tools and procedures aimed at improving practice were developed across the participating institutions. Several teams worked on observational approaches for gathering data about visitor experience—the idea of using observation as a tool for assessment was powerful to many participants, despite the time and effort such approaches require. One participant commented:

> *…we were able to step back and watch an activity take place and then look or kind of determine what we wanted to see as an outcome (compared to) what we were seeing; made some decisions on how we wanted to change that and then we*

would immediately make the changes within the activity and then step back and

watch again.

Some adapted existing protocols (e.g. Barriault & Pearson, 2010) as a way to better gauge how visitors were interacting with different elements of exhibits. Quasi-experimental designs were used to look at how visitor engagement might change as a result of a particular intervention (e.g. the presence of an educator or other onsite programming.) At one site, such a design was used to determine how best to improve visitor engagement with less 'charismatic' species.

Observations were also used as a way to assess the effectiveness of instruction during outreach programs. In one case, several iterations of observation led to the development and use of a refined observation tool. This tool focused on learner behaviors, not unlike commonly used classroom observation tools, as a way to help educators address elements of their practice that were not conducive to student participation or learner-centered investigation. For this group, the observation tool became an important part of staff training.

As described earlier, each team's Phase 2 project started with a question of how to best improve visitor engagement. For some, reflection on visitor engagement eventually led to considerations about how to train staff to better support visitor engagement. For one team, data was collected to better understand staff perspectives both before and after a

series of trainings related to visitor learning. This process of examining the impacts of

training led to a redevelopment of staff training efforts, which were later incorporated

into institution-wide strategic planning. At another site, the importance of promoting

visitor engagement through staff training led to a restructuring of staff management and

mentoring efforts. A more individualized approach, in which supervisory staff met with

educators and encouraged deeper reflection, gradually became part of a 'new normal'

practice at this particular site. Such concrete outcomes—whether they be new practices

or new tools—point to the power of action research as a process for promoting personal

or institutional change. Such outcomes even have the power to promote change across

the informal education field; tools adapted or developed by ZAARC participants have

been described at several professional conferences and shared through professional

networks.

Mentors and New Persepectives

ZAARC participants valued the expertise of the mentors, and the sometimes challenging

(or even frustrating) questions that were posed in ways that made educators stop or even

back up and think carefully about what they were doing. What kind of evidence would

you need? How would the design of the research project answer your question? How

will these answers help you improve practice? The conversations between mentors and

zoo and aquarium staff became important sparks for generating ideas and sustaining

interest for completing the different investigations.

I think it was the benefit of having a mentor there to kind of kick us into gear and remind us that we knew our jobs, we knew what we were supposed to be doing, it was just time to get doing it instead of continuing to question if we were going in the right direction.

…(having) somebody who is familiar with the world of which we are operating, familiar with the research project and can kind of reflect on the questions or challenges we were having from a broader sense. And be able to ask us questions, so that we could take our very vague statements and turn them into actionable items or at least decisions where we could say, okay we agree on this, let's move forward to the next piece. I think that was really useful, both in professional development but being able to move forward in the project and have it come to some kind of something.

Challenges

Community Constraints

Throughout ZAARC, the participating educators were tasked with thinking critically about their practice—the goals, outcomes, resources, and activities that they engage in

each day.   Practice, however, is not only shaped by the practitioners, but by the community within which these activities occur; many of the challenges identified by the ZAARC educators could be attributed to the tradition, policies, and expectations of the organizations within which they worked. It is important to note that the perceived constraints were not necessarily linked to an organization or administration—in fact, many of the educators were quite thankful for the flexibility that allowed them to take part in ZAARC. Rather, these constraints were more often seen as a function of their job and the field at large.

Many participants cited *a lack of time* as the biggest obstacle to their action research efforts. In ZAARC, we saw how zoo and aquarium educators struggled, but succeeded, to find and protect the time they needed to think deeply about program goals and ways they might modify their practice. Participants needed time to develop skills for gathering and interpreting the evidence needed to show that the changes they made led to desired improvements. Although educators were explicitly given time to work on ZAARC, weaving this 'assigned' time into an already overflowing list of responsibilities was a challenging proposition.

> *It was hard to find a time to commit to the project. We did our darnedest and I mean, we had a lot of internal things going on.*

Nothing was put on pause for this. So we had to continue to run full steam on everything else, even though we did get you know a modest stipend to help us to participate…. So the biggest challenge was finding the time to do everything.

The limitation of this critical resource of time has been cited in several studies of informal educator practice (Kisiel, 2010; Tran, 2007), and as such, may not be particularly surprising. Nevertheless, it reminds us of the challenge of reflecting on practice when there is little time to do so. Increasing the amount of this resource is no simple task, as it would seem that the use of time resources was a function of the community within which each of these educators practiced. Although the ZAARC project provided stipends to participating organizations in an attempt to free up practitioners' time, it was difficult for participants to figure out how to off-load any of the tasks for which they were responsible. For similar reasons, ZAARC was most successful when participants' research projects were closely aligned both with their job responsibilities and institutional priorities and when they had institutional buy-in.

I think we were fortunate that the support that we had allowed us to take time to work on it in a significant amount of time, and sorta justified – even within my own brain – that I was able to say, "Nope, this is something important on my plate. I need to give time to this instead of doing this, this, this." So it really validated that it was worth spending time on it.

Another challenge described by the ZAARC educators was related to the differences in job responsibilities. Although teams from each site were often selected based on the potential of the individuals, in many cases, the teams represented educators with different roles. Selecting a common practice for study and improvement, given somewhat disparate goals and responsibilities, proved to be challenging for some teams. In some cases, this led to identifying an action research project that was broad enough to inform the practice of all team members and indirectly helped break down intra-institutional walls. In one case, however, this led to the development of three different action research projects that allowed each educator to study a question that was specifically important to his or her own work. In this instance, the division of projects counteracted the advantage of sharing ideas in a small group. Issues such as these have implications for the choice of team members when there is an expectation that participants will work together.

What is 'Practical'?

One of the characteristics of action research that makes it such a powerful tool is the fact that it aims to answer a question directly related to improving practice. As such, it requires the educator-researchers to reflect more deeply on elements of their practice that they are particularly interested in understanding or improving. In addition to encouraging participants to focus on their own practice, ZAARC also sought to foster a community of action researchers, so the project began with all sites implementing *Be An Animal Scientist* described above. In addition, in the first several months, all participants read

research literature on visitor engagement in informal settings. Although the goal of these

two shared activities was to build community and to introduce the educators to what

doing research in an informal science setting might look like, several of the teams

questioned its utility and the relevance of the project to their own practice.

> *I think at the first institute most of what we were looking at was classroom*
>
> *examples, which, while very interesting, are harder to relate to what we could*
>
> *possibly do. And I know we also looked at some of the Exploratorium examples*
>
> *and then we spent a lot of time looking at the Animal Scientist activity. So that*
>
> *was also distracting because that was the method we were going to use to do*
>
> *action research, but that itself was not action research.*

In Phase 2, once ZAARC shifted to a focus on the improvement of practices that were

specific to each team, the educators became more engaged in the ZAARC process, and

the confusion associated with *Be An Animal Scientist* (and whether it was a worthwhile

exercise) diminished. Generally, the participating educators pointed to their experiences

studying aspects of their practice when speaking about the benefits of ZAARC. It would

seem that many educators (both formal and informal) are deeply immersed in their

practice and what is needed to get the job (or jobs) done. As such, pulling them away

from those activities, and using their time to introduce new strategies for understanding a

practice in which they are NOT directly engaged may make it difficult to tap into an

intrinsic motivation for participating in new practices--a core goal of ZAARC.

Participants' mixed reactions to Phase 1 of ZAARC highlights a fundamental design tradeoff between ensuring that every aspect of a program is immediately relevant to individual participants and providing shared experiences that provide the basis for community-building.

Need for Guidance

Developing a mindset for reflecting on practice is not trivial—for many it requires pulling out of the day-to-day, if only for a few minutes, to gain new perspectives on goals, objectives, roles and even identity. In the case of ZAARC, reflection also included considering what elements of practice—program design, program implementation, interpreter training, etc.—would benefit from a closer look and subsequently, what might serve as a relevant research question. Many ZAARC participants had difficulty thinking about just what element of their practice they wanted to study. For many, the challenge came in narrowing down the scope of their inquiry, because they wanted to know everything about everything they did. Were students learning? Were visitors learning? Were staff interactions effective?   How do we start?

As mentioned earlier in this chapter, one way that the project was able to meet the needs of these educators was through the involvement of several mentors experienced in research, evaluation, and informal learning settings. These mentors took on slightly different roles from group to group, but across the board, the educators saw them as an

integral part of the ZAARC process. For some teams, the mentors provided the structure

needed to ensure that there was time for reflection and for carrying out the action

research project. The scheduled phone meetings, as well as several in-person meetings,

served as effective motivators for staying with the project and moving the plans to

actions.

> *I think knowing that we had a phone conversation with (our mentor) coming up, it*
>
> *would make us meet to make sure we were all on the same page about where we*
>
> *were going or to have that dedicated time, to set aside, you know, an hour to kind*
>
> *of prep and see where we were and just kind of talk things through.*

> *But honestly, the monthly phone calls and the check ins; that's when we would all*
>
> *be like, "Oh, yeah, we should get together and check in with each other before we*
>
> *have to check in with our mentor."*

Without the structure that meetings with mentors provided, the limitations of time and

institutional culture may very well have prevented the completion of some of the action

research projects.

Final Thoughts

The ZAARC project affirmed our hypothesis that action research could be a productive basis for professional development and could contribute to improvements in practice. In reflecting on the ZAARC project, several aspects of the professional development model we created and studied stand out to us as critical components of ZAARC's success.

- Involving a team of participants from each site, to provide mutual support and partners to think with.

- Scheduling periodic in-person meetings and frequent online or phone interactions with a mentor.

- Creating a focus on a general issue of interest to all – in the case of ZAARC, on visitor engagement and behavior.

- Fostering a cross-institution community.

- Providing opportunities for participants to share the work they do with a professional community in both oral and written form.

- Rooting activities in participants' work, thus providing immediate opportunity for practical application.

- Providing modest financial support.

With the publication of the collection of ZAARC action research reports in our 2016 book, this phase of work on ZAARC will end, although the project staff has been actively seeking funding to expand the approach to a larger group of zoo and aquarium educators. Even without additional funding, the effects of ZAARC continue to be felt in many of the

participating institutions, as described by a manager at one of the ZAARC sites who was not himself a participant.

> *[In the future], I think the answer may be to make the project powerful enough that several (or many) institutions will be changed by the intervention and the intervention will render itself unnecessary through fostering positive institutional changes. Speaking from [institutions]'s perspective, I can say that round one of ZAARC has had a lasting impact. Even without funding, we're using lessons from the project.*

References

Ballenger, C. (2009). Puzzling Moments, Teachable Moments. NY: Teachers College Press

Ballenger, C. (1999). Teaching Other People's Children: Literacy and Language in a Bilingual Classroom. NY: Teachers College Press Ballenger, C. (Ed.) (2004).

Barriault, C., & Pearson, D. (2010). Assessing exhibits for learning in science centers: a practical tool. *Visitor Studies*, *13*(1), 90-106.

Kisiel, J. (2010). Exploring a school–aquarium collaboration: An intersection of communities of practice. Science Education, 94(1), 95-121.

Reason, P., & Bradbury, H. (Eds.). (2006). *Handbook of Action Research: Concise paperback edition*. London : Sage Publications.

Tran, L. U. (2007). Teaching science in museums: The pedagogy and goals of museum educators. *Science Education*, *91*(2), 278-297.