Conservation Educator Academy at the Simon Skjodt International Orangutan Center: Developing Inquiry Practices for K-12 Classrooms

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Abstract

Teaching inquiry science is an important goal of the Next Generation Science Standards (NRC, 2013). While content knowledge is still important, "practices of science" bring the processes to forefront. Teachers need opportunities to develop authentic and engaging inquiry lessons that feature the practices. The Conservation Educator Academy at the International Orangutan Center fosters interaction with researchers who use the practices to facilitate teachers' implementation of the practices. The Center is a new exhibit at the Indianapolis Zoo that serves as both an exhibit and a research facility. Researchers study learning and cognition in the primates using touch screen computers, and keepers use practices like questioning, observation, data collection, analysis, and proposing solutions to care for the animals. Teachers in the CEA learn about orangutans, their environment, threats to their survival in the wild, and the cognition research. Discussions focus on the practices and their application to standards. Teachers develop inquiry lesson plans to use in the following school year, and engage in ongoing reflection and revision. The project examines the design of the PD program, its impact on teacher practices, and student learning outcomes. The presentation will share program design and data collected in the pilot program.

Developing K-12 Inquiry Practices:
The Conservation Educator Academy at
the Simon Skjodt International Orangutan Center

Introduction

For educators, especially science educators, informal education institutions have always been associated with teaching practice. Often this connection is on the periphery of what science teachers do. The occasional field trip, the example cited in a class discussion or lecture, or a source of some curriculum materials. For many years, studies have examined the impact of field trips and visits on students' learning of science (de White & Jacobson, 1994; Marshdoyle, Bowman, & Mullins, 1982).

But for teacher educators and educational staff at zoos, museums, nature centers, and other providers of informal education, we have been seeking a deeper connection. There is a need and a growing body of literature examining teacher preparation models in which informal education is a closer partner in improving science education in the K-12 schools (Olson, Cox-Petersen, & McComas, 2001; Phillips, Finklestein, & Wever-Frerichs, 2007; Smith, McLaughlin, & Tunnicliffe, 1998). In this paper, the authors share the design of a teacher professional development project that positions the Indianapolis Zoo as a partner and resource for teacher preparation as well as K-12 science teaching. The project, called the Conservation Educator Academy, attempts to add to the expanded vision of informal education in the revision of formal education.

This new vision for the relationship between informal education and teacher education can be more than preparing teachers to take their students on a field trip. Zoos and museums are a place where teachers and students can see real science in practice, and even participate in the process. The "practices" emphasized in the Next Generation Science Standards (2013) are part of the daily routine in caring for animals and conducting the research that takes place behind the scenes. This goal for the informal-formal education interface is not new. The literature includes mention of professional development at informal education institutions designed to foster learning of "scientific investigation processes," an idea that aligns very closely with the "practices" embodied in the NGSS (Hofstein & Rosenfeld, 1996, p. 100).

By allowing teachers to see these activities and interact with staff, professional development can enhance the use of these same practices in the science classroom before, during, and after students' direct interaction with the zoo. In order to maximize this impact, teachers should be brought to the zoo to learn about the zoo's practices, imagine ways to implement the practices into the classroom, and create the lesson plans and curricular materials they need to engage their students in the authentic practices of science. This is one of the primary goals of the Conservation Educator Academy (CEA) at the Simon Skjodt International Orangutan Center

The CEA also has a shared goal to impact the conservation of species, especially the orangutan. Littledyke (2008) cites the need to address learners' attitudes about the environment as part of K-12 education, and the CEA attempts to address this goal. The workshop's activities and discussions with Zoo staff helped teachers learn about issues relating to conservation of habitat and the impact humans have directly through unsustainable farming techniques in Indonesia and indirectly through consumer choices around the world. By including teaching about these issues, the CEA may impact not only the teachers, but their students' understanding of environmental conservation as well. The authors view teacher professional development as an important tool that has a positive impact beyond the classroom, so the CEA was designed with conservation as central theme.

In recent years, state and federal officials have highlighted STEM education as an area for greater emphasis in our schools. Developing science skills is seen as a matter of national interest because of its impact on economic development, national security, and the creation of innovative technologies. In their "Report to the President," the PCAST (2010) call for development of initiatives to "prepare and inspire" students to pursue careers in the STEM fields. This recent emphasis on STEM education is also reflected in the *Next Generation Science Standards* (National Research Council, 2013), the most recent set of expectations for science teaching and learning. The *Framework* (NRC, 2012) established for these standards makes it clear that students across all grades need to practice and apply the eight "practices" of science and engineering as they learn science content and crosscutting concepts.

Inquiry teaching strategies stressed by the previous *National Science Education Standards* (NRC, 1996) are effective in engaging students in these practices. However, other pressures have worked against efforts to increase the use of inquiry-based pedagogies in K-12 classrooms. Teachers feel pressure to "cover the standards" and prepare students for standardized tests, leading to a narrowing of the range of instructional strategies employed by teachers (Faulkner & Cook, 2006; Mertler, 2011). Teachers are retreating to methods that are efficient in preparing students for tests – more lecture and worksheets, less student-centered inquiry and authentic problem solving. The result is that fewer students are engaging in the "practices" of science.

This trend shows a need for teacher professional development (PD) that "prepares and inspires" teachers (PCAST, 2010) to adopt an inquiry orientation to their teaching practice. This proposed presentation describes a teacher PD program designed to accomplish this goal. The Conservation Educator Academy is a PD program that intends to address this need.

The first cohort of teachers convened at the Zoo in June 2014 as a pilot program. Twenty-three teachers in grades K-16 enrolled in the program. Project activities included three days of workshop sessions at the Indianapolis Zoo, with continued participation in online learning communities through the summer and the following academic year. Table 1 shows the program activities in tabular form. The proposed presentation will describe the project, provide examples of the lesson plans teachers produce, and data about teachers' practice and beliefs about teaching science and project evaluation.

Research being conducted in the project is guided by the following questions:

- *How effective does the Conservation Educator Academy impact K-12 science teaching and learning?*
  - *How do teachers' inquiry practices change as a result of the CEA?*
  - *What impact does the CEA have on science teacher efficacy beliefs?*
  - *How do the lesson plans influence student learning?*

Table 1

Conservation Educator Academy Design

PD Phase	Schedule	Activities
Summer Workshop	June 23-25	Tour of Center; observe IOC learning lessons; behind-the scenes tours; interact with zoo staff; workshops on inquiry, rubric writing & GIS software
Lesson Planning	June 23 – August 1	Lesson topic development; explore state standards; write objectives; outline of lesson plan; assessments and resources; building sequence of activities; materials development
Implement and Reflect	2014-15 school year	Reflect on design of plan; implement lesson; analyze student work; revise lesson plan

The Conservation Educator Academy at the Simon Skjodt International Orangutan Center

In 2012, staff and administrators at the Indianapolis Zoo contacted universities in the state seeking partners for a PD project that would focus on helping teachers develop inquiry-based curriculum to engage students in authentic STEM practices. The program was intended to involve a new exhibit in which scientific research would take place, including activities that would take place in view of the public. Ball State University shared the Zoo's views on science teaching in K-12 classrooms and teacher professional development, so the Indianapolis Zoo and Ball State University created a partnership that became the Conservation Educator Academy.

The CEA was developed to coincide with the opening of the Zoo's new Simon Skjodt International Orangutan Center. The Center is both a public exhibit and a research facility currently housing eight orangutans. Researchers at the Center study primate cognition with "learning lessons" to examine the ability of the apes to learn symbolic languages through cooperative activities using touch-screen computers. The lessons also examine the orangutans' ability to learn number sequences and complete interactive tasks on the computer screen that require shared cognition with a researcher, keeper, or zoo guests. The learning lessons are completed during zoo hours in a room with space for visitors to watch and interact with the researchers. Dr. Robert Shumaker, the Zoo's Senior Vice President of Conservation, Science and Education, and one of the leading experts on orangutans and primate cognition, directs the research conducted at the Center.

In their research, Shumaker and his team use the same "practices" that we want students to develop, so the Center serves as an engaging and inspiring model for scientific inquiry. Dr. Shumaker and his team develop testable questions, plan and implement experiments, control variables, collect and analyze data, explain results and communicate their results. Each of these activities is included in the list of "processes" of science listed in the Indiana Science Standards (IDOE, 2010) and the "practices" (NRC, 2013) featured in the Next Generation Science Standards. The close parallels between these two sets of expectations is shown in Figure 1.

Process Skills (IDOE, 2010)	Practices (NGSS - NRC, 2013)
• Make predictions, develop testable questions • Plan/carry out investigation • Collect quantitative data • Incorporate variables that can be changed, measured or controlled. • Accurate record keeping • Analyze data • Make inferences based these patterns. • Compare results with prediction. • Communicate findings	1. Asking questions (for science) and defining problems (for engineering) 2. Developing and using models 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematics and computational thinking 6. Constructing explanations (for science) and designing solutions (for engineering) 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information

***Figure 1:* Comparison of science processes and practices (IDOE, 2010; NRC, 2013).**

The Indianapolis Zoo also presents multiple contexts in which students can engage in meaningful scientific inquiry. Questions students can ask and investigate through Internet research, observation, data collection and mining, and building models are almost limitless. The goal of the Conservation Educator Academy is to bring teachers to the Zoo so they can interact with the staff, exhibits and animals as a way to learn how the practices are enacted at the Zoo.

To facilitate this learning, the CEA includes behind-the-scenes tours in exhibits around the zoo. In the first cohort, participating teachers viewed the off-exhibit portions of the Desert Biome and the Oceans exhibit. Staff in these facilities practice the science processes on a daily basis by recording observations and data, making hypotheses about the health of animals, and helping veterinary staff and researchers care for and study the animals. These functions are critical to the operation of the zoo, and usually go unnoticed by visitors. CEA participants also took part in presentations and discussions with staff and researchers at the Zoo in a classroom setting, discussing the types of research, the challenges of conducting these studies, the care of the animals, and the connections between research and the Zoo's conservation efforts.

Teachers also learned about the biology and natural history of the orangutan, their habitat, and the design of the Center as a model of the orangutan's natural environment. The International Orangutan Center was built to be a functional or metaphorical model of the orangutan's natural habitat. While the habitat does not look like a rain forest, the open spaces and design of the facility provide the orangutans with choices. Each individual can choose where in the three-dimensional space they wish to spend their time, and can move about by climbing ladders, bars, "vines" and posts. The exhibit includes the Hutan Trail, a series of towers connected by bars and cables that serve as a treetop highway for the orangutans to move about outside the exhibit. CEA participants spent time exploring the exhibit and interacting with the Zoo's education staff and volunteers to gain a better understanding the design of the exhibit, the purpose of each of its features, and the ways in which the orangutans use the facility.

The PD activities also included discussions about conservation of orangutans and their habitat in the wild. The Indianapolis Zoo is directly involved in efforts to protect the orangutan's habitat in Indonesia through its membership in the Roundtable for Sustainable Palm Oil (RSPO) and the Palm Oil Task Force through the AZA. Zoo staff shared information about programs to introduce sustainable methods for growing oil palm, the primary crop in the Indonesia that threatens the rain forests in which the orangutans live. Discussions included how the oil palm are grown and the economic impact on the human population, the rate at which rain forests are being clear cut, and the types of products that contain palm oil. The Zoo also shared information about conservation efforts at international, national and local levels. Many of these include activities that can engage K-12 students and their families.

These observations and discussions led to questions about orangutan physiology and the engineering of a zoo exhibit upon which engaging lessons might be developed. The development of these creative questions is directly tied to another element of Conservation Educator Academy. As participants began to develop ideas for inquiry lesson ideas, the Ball State Faculty led discussions about inquiry teaching and strategies for fostering inquiry learning. Teachers took part in an inquiry activity using the botanical gardens and the Zoo's landscaping and talked about features of inquiry lessons. This part of the workshop also focused on "levels" of inquiry as defined by Bell, Smetana and Binns (2005). Other sessions focused about Geographical Information System (GIS) as an inquiry tool, writing rubrics, and assessment strategies.

Other planning activities included brainstorming, exploration of state standards, and initial planning of a lesson plan using a template developed by the lead author (see Appendix). Work sessions were planned to let groups of teachers talk about their plans, develop materials, find online resources, or make plans to include visits to the Zoo. CEA facilitators supported teachers as they considered plans for assessing learning, and helped refine the lesson ideas. At the end of the summer workshop, the teachers presented their lesson ideas, and received feedback from their peers about revising the plan, finding resources, and building collaborations.

In addition to the Summer Workshop planning, teachers devoted time during the next five weeks to completing their lesson plans using the inquiry lesson planning template. The template asks teachers to identify the topic, the central concept, objectives and learning outcomes, standards, and assessment strategies. The template also includes a sequence of activities, alignment with the 5E Learning Cycle model (Bybee, 2006), materials and resources, and a lesson calendar. Teachers are asked to attach teacher instructions, student handouts, assessment instruments and rubrics, and a bibliography. Teachers submitted their lessons prior to the start of the school year.

The participants were then asked to finish the lesson plans by the beginning of August and to teach the lesson during the school year. A series of reflection prompts were posted online through Ball State's Blackboard software to help teachers write about their lessons, analyze student work, and revise their lessons after teaching them. At the time of this presentations, teachers are being asked to submit the revised lesson plans to be published on a project website.

Research on PD Design

Teachers in grades K-12 were recruited for the Conservation Educator at the state's science teaching conference in February 2014. The target audience for the project includes teachers across the state in a wide range of school communities. Participating teachers were able to attend the workshop without an enrollment fee, and were not offered any financial incentive for their participation. After cancellations prior to the start of the Academy, the first cohort of teachers included 23 teachers. Three of the participants were K-2 teachers, eight middle school (gr. 6-8) teachers, ten high school teachers, one university instructor (nursing), and one pre-service high school biology teacher.

Participants were invited to give informed consent to use their information for research, including survey data, discussion forum posts, lesson plans, and videotaped workshop and interview sessions.

The Academy consists of three phases: Summer Workshop, Lesson Planning, and Implementation/Reflection. The Summer Workshop met for three days at the Indianapolis Zoo, Lesson

Planning involved independent work supported by Ball State's Blackboard course management system, and Implement & Reflect phase will take place in the 2014-15 school year.

In this first cohort, research focused on evaluating the design of the program and its impact on teachers' practices and exploring strategies for assessing the impact of the Academy on student learning. Data was collected during the summer workshop, and teacher writing and lesson plans are being collected through Blackboard. In the following section, we share a description of the data collected and a brief discussion of preliminary findings.

Data Collection Summer Workshop

During the Summer Workshop, CEA planners administered three surveys to collect information about participants' efficacy and inquiry practices, and feedback about the design of the program to be used for program revisions.

The surveys administered include pre-workshop administration of the Science Teaching Efficacy Beliefs Instrument (STEBI-A; Riggs & Enochs, 1990), and the Inquiry Inventory Survey (IIS). This survey is a well-established instrument that includes 25 Likert-scale questions. Responses were compiled to provide an overall STEBI score, and two subscores: the Science Teacher Outcome Expectancy (STOE) that assesses teachers' belief that an effective teacher's actions can impact students' science learning; and the Personal Science Teaching Efficacy (PSTE) that describes a teacher's belief that he or she is able to be an effective science teacher.

The IIS is a new survey adapted from the *Inquiry Self-Assessment Survey* (Llewellyn, 2007) to assess teachers' inquiry practices in a 23-question Likert-scale survey. The data from the ISS was analyzed to identify specific areas of need that might be addressed in the Summer Workshop. The initial descriptive statistics are presented below, but a more valuable analysis will be comparison to post-workshop surveys to be administered and analyzed in May 2015.

A program evaluation survey consisting of 10 Likert-scale questions and three open-response questions was administered on the last day of the Summer Workshop. The Likert scale questions were analyzed to provide descriptive statistics, and the open-response items were reviewed to identify elements of the PD program that need revision for the following year.

Another source of evidence is a collection of videotaped recordings of the PD activities. A team of videographers from Ball State's iLearn Center recorded videos of behind the scenes tours, IOC tours and learning lessons, lesson planning sessions and workshops, and behind-the-scenes tours. They also recorded interviews with seven teachers on the last day of the workshop, and this data may provide evaluation feedback to supplement the evaluation survey. These videos have not yet been analyzed, and are not discussed in this paper.

Preliminary Findings

For the pilot program, research on program evaluation and the impact on teachers is an important goal. The research questions described in the previous section only include pre-assessments because the post-assessments have not yet been administered.

STEBI Survey

Data from the STEBI-A survey are shown in Table 2. The data presented includes the STOE and PSTE sub-scores and the overall STEBI score, an average of all 25 questions. The STEBI-A version of the survey was selected because it was written for practicing teachers. The questions included in the survey can be found in the Appendix.

Table 2

STEBI-A survey – Pre-assessment (June 2014)

Score	Median	Mean	Std. Deviation
STOE	3.420	3.417	0.383
PSTE	4.170	4.216	0.455
STEBI	3.745	3.816	0.337

n = 23 Scale = 1-5

The STEBI Survey pre-assessment data suggest that participating teachers entered the CEA workshop with a relatively high sense of self-efficacy toward their science teaching ability (PSTE = 4.216 out of

5.00). This result makes sense in light of the group of teachers enrolled in the first cohort. The participants included several experienced teachers who are regular participants in the state's science teacher association. The teachers reported extensive previous experience with professional development, and entered the project with high level of confidence in their ability to teach. There were only three teachers in the cohort in their first four years of teaching experience, and group we might expect to have a lower PSTE score.

The participants scored lower on the STOE subscore (STOE = 3.417 out of 5.00). These data may suggest that teachers do not feel that effective teaching alone impacts student learning. The implications of this result are not yet clear, and we will need to evaluate this data more thoroughly after the post-assessment data is collected.

IIS Instrument

The Inquiry Inventory Survey provides self-reported data about a teachers' use of inquiry teaching practices. The questions can be seen in Table 3, along with the data from the pre-assessment.

The data presented are of limited value as an assessment of actual teaching practice. To better assess what happens in the classroom, and observation instrument would be more useful, but with limited resources, the CEA has not yet been able to implement classroom observations. Until a post-assessment administration of the instrument is completed, the data cannot be used to evaluate the impact of the PD program, but it may suggest items that we should examine in the final analysis.

In Table 3, the means for eight of the items are highlighted and marked as indicators of "need for teacher improvement." The questions in this set include items asking about inquiry in which students select the questions to investiage (#1), plan the investigation (#2), design experimental procedures (#7), use skills from other content areas (#10), and record data and observations in a journal or lab notebook (#21). These five questions address specific practices (NRC, 2013) and processes (IDOE, 2010) that were highlighted in the workshop. The relatively low scores on these items (ranging from 2.727 to 3.500 out of 5) might be expected to be higher on the post-test if teachers adopt the strategies discussed in the workshop and highlighted in the sample inquiry project on the first day of the workshop. The response on these items indicate that teachers report the use of these strategies 1-4 times a year. One goal of the project is to increase the frequency with which teachers engage students in these inquiry-based practices.

Two other questions focus on the use of the 5E Model of Instruction (Bybee et al, 2005) (#9) and an engaging activity to begin a new unit (#8). These items (2.000 and 3.500) were addressed in the workshop as well. The lesson planning template used for the lesson plans in the CEA explicit ask the teacher to use the 5E model, and one of the workshop sessions highlight the 5E model, including using an engaging activity to introduce the lesson or unit. If the instruction on this aspect of inquiry teaching was effective, we might expect an increase in these two items on the post-assessment.

A final question labeled as an area of need is #22. This assesses the use of performance assessments, a strategy that is well suited for evaluating students' use of inquiry practices in authentic contexts. The Summer Workshop included discussion of performance assessments, and teachers were encouraged to consider using this strategy with their project lesson plan. This emphasis on performance assessments may lead to a higher score on this item in the post-assessment.

Responses to the other questions on the ISS reinforce the researchers' inference that most of the teacher are experienced and effective science teachers we discussed in the section above. Teachers reported using fourteen of the items "at least once in each unit," so we might expect scores on these items to remain stable in the post-assessment.

Table 3

IIS Responses for each question – Pre-assessment (June 2014)

Question	Median	Mean	SD
1. I provide lessons in which students explore questions that interest them.	3	**3.277***	1.193
2. I provide resources and manipulatives to stimulate students' curiosity and thinking skills.	5	4.318	0.945
3. I emphasize process skill development as part of my lessons.	5	4.364	1.049
4. I design my curriculum with student-centered lessons in which students plan their own investigations.	3	**2.864****	1.246
5. My curriculum uses various primary sources of information in addition to the textbook.	4	4.227	0.813
6. My role as a teacher is that of a facilitator while students are actively solving problems or doing experiments.	4	4.136	1.037
7. I provide opportunities for students to design the procedures and data tables for their own investigations.	2.5	**2.727****	1.077
8. My units begin with a highly motivating problem, question, or demonstration.	4	**3.500***	0.913
9. I use the 5E Learning Cycle to plan lessons.	1	**2.000****	1.345
10. I plan and teach lessons in which science is integrated with other subject areas.	3	**3.500***	1.058
11. I provide opportunities for students to share their ideas and points of view in class.	5	4.727	0.550
12. During a lesson, I move throughout the room, speaking from different areas of the room.	5	4.773	0.869
13. In my room students are engaged in investigations, discourse, and reflection.	5	4.636	0.790
14. I encourage students to be self-directed learners.	4	4.095	0.995
15. I frequently plan lessons that are both hands-on and minds-on.	5	4.545	0.596
16. I encourage cooperative learning relationships among students.	5	4.682	0.780
17. I pose various levels of questions to students.	5	4.682	0.716
18. I consistently ask open-ended questions to encourage students to think at higher levels.	5	4.500	0.802
19. I often follow up students' responses to questions with extension questions.	5	4.273	1.032
20. I use multiple assessments to evaluate student progress.	4	4.045	1.046
21. I have students use journals to record and organize their notes from class discussions and their scientific investigations.	4	**3.273***	1.723
22. I use performance assessments and projects as a part of my science teaching.	4	**3.682***	0.839
23. I regularly observe and assess critical thinking skills in science as part of my evaluation of the students' progress.	4.5	4.091	1.912

n = 23 Scale: 1 – Never; 2 – 1-2 times/year; 3 – 3-4 times/year; 4 – Once each unit; 5 – Almost daily

* Indicates area of slight need for teacher development

** Indicates area of need for teacher development

Evaluation Survey

The goal of the evaluation survey was to provide data for planners to use in revising the program for a second cohort. The questions were written to assess participant's opinions about how well the CEA addressed specific needs and project goals. The open response questions elicited specific feedback about features of the program teachers found most useful or would recommend we change. A copy of the survey can be seen in the Appendix.

Patterns in the data revealed a high level of satisfaction with the Summer Workshop (4.6 on a 5-point scale, SD=0.48). The quantitative data, though, may not be very useful in guiding revisions because they do not indicate issues that were not effectively designed or taught. A summary of the patterns on responses for the 10 items on the evaluation survey is shown in Table 4.

Table 4

Evaluation Survey Results (June 2014)*

Question	Median	Mean	SD	Range
Q1	4	4.22	0.518	4-5
Q2	5	4.39	0.783	2-5
Q3	5	4.65	0.487	4-5
Q4	5	4.70	0.470	4-5
Q5	5	5.00	0.000	-
Q6	5	4.83	0.388	4-5
Q7	4	4.30	0.703	3-5
Q8	5	4.65	0.573	3-5
Q9	4	4.35	0.487	4-5
Q10	5	4.87	0.344	4-5

n = 23

Scale from 1 (strongly disagree) to 5 (strongly agree)

*See Appendix for survey questions

Open-ended Responses

The qualitative information in the open response items were more useful. Several themes emerged in the teachers' answers in this section of the survey. The patterns of responses and samples are shown in Table 5.

When asked what parts of the workshop were most valuable, teachers reported that they valued conversations with keepers and researchers and the time to develop lessons plans. Others cited the time to work on lesson plans they can use. This pattern reflects the features of effective teacher PD described by Loucks-Horsley, Stiles, Mundry, Love, and Hewson (2009).

Participants also described the activities they were most likely to use from the workshops activities. Themes emerging from these responses focused on inquiry and the strategies shared for teaching and assessing learning in inquiry-based lessons.

Table 5
Patterns in Open-ended Responses, Evaluation Survey (June 2014)

Question	Emergent Themes	Excerpts
Question 11: What specific features of the IOC Educator Academy did you find most valuable?	Interaction with Zoo staff	- *The ability to talk to the zookeepers & ask questions.* - *Dr. Rob training session, Dr. Martin training info,"Behind the scenes" tours were awesome*
	Time to develop lesson plans	- *The lesson plans that we created will be implemented.* - *Time to explore the creation of lesson plan with assistance.* - *The time inside the zoo and especially w/ researchers & zoo staff was most useful.* - *Hands on experience with zoo staff* - *Behind the scenes!! It's great to talk to professionals that use science every day.*
	Inquiry models and strategies	- *Helping me define inquiry.* - *Inquiry info/intro enlightened me on the fact that there are many forms of inquiry*
Question 12: What aspects of the Educator Academy will have the most immediate impact on your classroom instruction?	Inquiry models and strategies	- *Learning about science through inquiry & backwards design* - *Using inquiry!* - *Confidence that I do inquiry.* - *Finding ways to increase observation skills of my students* - *Use of lesson inquiry design model* - *New ideas for inquiry* - *I feel I have a better definition of "inquiry"*
	Interaction with Zoo staff	- *The time spent @ the IOC w/ Dr. Rob, watching him administer the touch-screen testing and the information Dr. Martin shared with us.* - *Content information provided by the zoo staff.* - Interactions with zoo animals & staff.
	Zoo resources	- *The new knowledge of zoo resources and ways to look at the zoo will help provide a new aspect to my lessons.* - *Information on orangutans* - *New knowledge of the animals, programs, & options here at the zoo.* - *Borrowing suitcases/games from zoo* - *Resources from zoo/collaboration*
Question 13: What improvements would you suggest for our future Educator Academies?	More time!	- More time to collaborate. - More time in the zoo ☺ - I would like to have the days extended, so that we could work with Dr. Tom and Tolly on our lessons to ensure that they are beneficial to the zoo. - More zoo time & more work time for lesson plans. -
	Return visit for past participants	- *Having a second session in the future to discuss how things went overall. Secondary level of conference where the group might meet one day next summer?* - *I would be wonderful to have a continuation next summer for this inaugural group, 1-2 days – CEA 2*
	More interaction with zoo staff	- *More time with the trainers.* - *More interactions with keepers/enclosures*

Implications for Teacher Educators, Science Teaching and Learning

The Conservation Educator Academy at the Simon Skjodt International Orangutan Center represents a model for a partnership between information education institutions and teacher educators. If lessons learned from the Conservation Educator Academy can be used to develop similar programs at other institutions, there may be benefits for both formal and informal educators.

Even though the research presented in this paper are preliminary and have not been compared to post-assessment data, a few implications may be suggested by the data. These implications relate to the needs of K-12 teachers for professional development, the features of inquiry-based science teaching that need to be included in professional development plans, and the nature of the relationship between teachers and informal educators that may have the greatest impact on K-12 teaching and learning.

The data collected from STEBI data suggest that teachers may experiences that demonstrate that inquiry teaching practices have a positive impact on student learning. While the teachers in the first cohort of CEA participants seems to have confidence in their ability to teach science, their STOE scores suggest they have less confidence that good teaching will lead to better understanding of science among their students. A long term goal for the CEA and other PD programs should be to collect evidence that inquiry teaching, as assessed through reliable observation protocols, does have a positive impact on student learning in the sciences. This will require extensive observation in classrooms and access to achievement data or other evidence of learning, but this data is critical in helping teachers recognize the importance of inquiry teaching.

PD planners can also enhance this aspect of teacher learning if participants have a positive experience with the inquiry lesson plans they develop. Another long-term goal of the CEA is to expand the project to include a more robust examination of student learning in participants' classrooms. The current model only uses teacher reflections to assess learning, and while teachers need to have a role in this process, science educators should work to develop a reliable and easy-to-use process for documenting evidence of learning.

The Inquiry Inventory Survey also reveals some areas of need in PD. The eight items for which teachers reported using inquiry-based strategies infrequently are skills students need to develop throughout their science coursework, so it is important for PD planners to highlight skills like developing testable questions, design experiments, recording data and planning research among K-12 students. The use of the 5E Model (BSCS, 2005) is not the only strategy that support inquiry learning, but the data from the ISS instrument suggest that teachers have not adopted the 5E Model in their daily practice. If science educators believe the 5E Model is still useful, PD programs should include practice and instruction in using this framework. There may also be a need to include school administrators in PD programs to help them recognize the importance of the framework and features of inquiry-based teaching so they can encourage their implementation during the teacher evaluation process.

The Evaluation Survey suggests that teachers in the CEA pilot program find the learning experiences at the Zoo to be valuable in helping them create engaging inquiry lessons. The feedback from participants echoes the literature on effective PD programs when teachers cited collaboration and lesson plan development as important elements in the program. But their responses clearly point to a need to foster interactions and partnerships between science teachers and practicing scientists. The participants nearly all mentioned the discussions with zoo staff and behind-the-scenes tours as one of the most valuable parts of the Summer Workshop. The CEA's planners have added another day to the workshop for Cohort 2 to permit more of these types of interactions in response to the data.

Other informal institutions also have staff who demonstrate the "practices" (NRC, 2013) of science and engineering every day. The authors encourage other institutions to explore the possibility of creating partnerships with schools and teacher educators that bring teachers into direct contact with their scientists to discuss how their institutions use the practices. These might include tours and presentations, or could be expanded to include internships and job shadowing.

But the evaluation data also reveal that teachers are mostly like to *use* the information if their learning is tied to lesson plan development. Most of the participants mentioned the importance of the time they spent planning lessons, especially in collaboration with their peers. Other research has shown that teachers place a high value on workshops that give them time to collaboratively create the materials they need when they return to the classroom, (Garet, Porter, Desimone, Birman & Yoon, 2001; Loucks-Horsley et al, 2009; Supovitz & Turner, 2000), and even this preliminary data from the CEA supports this claim.

The Academy may also result in improved utilization of educational resources already provided by the Zoo. The Indianapolis Zoo offers "suitcases" with learning materials to loan to schools, school field trips, and camps for students, but like most zoos, they hope to reach a larger population of teachers and students. The Academy may be able to provide evidence that participants are more likely to use the Zoo to support learning. Anecdotal evidence and the lesson plans teachers are beginning to submit from their work at the CEA show that some of the teachers in the program planned ways to utilize the Zoo's programs and resources. These teachers had not previously used the Zoo as a teaching resource. This may suggest that informal education institutions involved in teacher professional development can expect to expand the number of teachers and schools using their institution as a tool for teaching.

Future PD and Research

As the authors plan for the next cohort of teachers in the Conservation Educator Academy, the implications above represent a need to collect more data to support the implementation of the CEA model. The sample size of teachers (n=23) is not large enough to provide generalizable data, but the contribute what we hope will be a larger body of data. Project leaders are seeking funding to expand the model, reach a larger group of teachers, and compile a growing collection of inquiry-based lesson plans. Another goal for future research is to fund personnel to spend time in participants' classrooms to better assess the impact on teaching practice, and to develop a plan to assess the impact on student learning. Longitudinal studies of teachers and students in participants' classes could be conducted to see if the project improves student interest in science courses and careers. There are also numerous ways to examine learning of the Disciplinary Core Ideas and Crosscutting Concepts presented by the Next Generation Science Standards.

The Conservation Educator Academy also presents multiple opportunities to extend research to include additional questions. In addition to examining the impact of the workshop on teaching practices and student learning outcomes, the CEA planners anticipate presenting the workshop using other exhibits at the Zoo. If the model is flexible, applying the same approach to professional development at the Zoo should be just as effective if we use elephants, dolphins, lemurs or koala bears as the central focus. For other institutions, perhaps that focus could relate to a habitat at a nature center, an exhibit at a museum, or a specific research project about nearly any topic. In 2015, the CEA will continue its work with the International Orangutan Center, but planners have already discussed other species and exhibits that might be used in the following year. Studying the impact of this type of variation may help reveal the aspects of informal education and features of a science topic that lead to higher teacher and learning engagement.

The next stages of the Conservation Educator Academy will continue to explore the informal-formal education partnership and its impact on teaching and learning in the K-12 setting.

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