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Dialogue among educators: Understanding the intended goals and perceived roles within a non-formal and formal educator partnership

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Abstract: Even less well known than how non-formal education is woven into formal education is how classroom teachers and non-formal educators work together to plan and implement these kinds of partnerships in the classroom. This study sought to explore how to intentionally and effectively structure the partnership between a formal and non-formal educator. The results of the study indicated that formal and non-formal educators can support each other's goals through systematic collaboration in a robust and dynamic partnership that necessitates working together both prior to and during the implementation of programs to define goals and iteratively gauge roles of each educator in the process. Suggestions are made for how both educators can be made aware of the commitment involved in an explicit collaboration, including materials needed, expected levels of communication, individual roles, assessment aims, and time needed for effective outcomes.

Keywords: non-formal science education; formal science education; environmental education; teacher partnerships

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1. Introduction

As efforts are being made to engage students in science, non-formal and formal science education partnerships have been shown to 1) lead to conceptually rich and compelling science learning programs; 2) lead to the creation of learning communities that could develop practices, dispositions, and understandings that are of value across multiple institutional settings and boundaries, and 3) create more equity and access for children, and teachers of children, from high-poverty communities (Bevan et al., 2010). Research on non-formal and formal science education collaborations has revealed that they take significant time and energy, but are valuable experiences for both students and institutions. Prior research suggests there are numerous benefits of integrating non-formal learning within formal settings. Science attitudes and confidence (Kelly, 2000), scientific reasoning (Gerber, Cavallo, & Marek, 2001), and interest in science (Zoldosova & Prokop, 2006), have all been shown to increase due to non-formal science learning. Hofstein, Bybee, and Legro (1997) discuss the *National Science Education Standards* and how scientific literacy could be enhanced by partnerships between formal and non-formal science education. These suggestions call for a hybrid approach to teaching science, where non-formal science instruction enhances formal classroom instruction.

Hofstein and Rosenfeld (1996) assert, however, that while we have good reason to believe that non-formal learning experiences can enrich school science, "We know relatively little about how these experiences can best be integrated into the school curriculum (p.107)." Thus, more information is needed on how to effectively blend non-formal and formal learning experiences in order to significantly enhance the learning of science. After reviewing numerous non-formal and formal science education partnerships, Bevan et al. (2010) argue for more intentional and strategic partnerships, leading to collaborations that build on particular knowledge and strengths of different institutional types "to meet shared goals of making science learning more accessible and compelling to young people in our communities" (p.60). They contend:

> We do not advocate strict alignment or lock-step agreement [for formal and non-formal education], or for carving up the universe of science learning ("you do engagement and we'll do learning"). Rather, we propose that the best way forward is to intentionally establish systemic relationships between formal and informal institutions, with the goal of creating greater coherence and access. (p.61)

Non-formal science education includes field trips, museums, parks, libraries, and programs facilitated in schools by non-formal educators (Rennie, 2007). According to the widely accepted definition, non-formal education is the learning that occurs in a formal learning environment (workshops, symposia, extracurricular courses and programs, etc.) but that is not formally recognized within a curriculum or syllabus framework. Non-formal science programs include learning that is often less directed and students are encouraged to make decisions on what is to be learned and seek help on the how or means of the learning activity. In contrast, formal learning includes settings where learners have little control over what or how they learn because of mandates by the state or school district.

In another vein, formal and non-formal educators likely bring different funds of knowledge (understandings, skills, and experiences,) that can mutually benefit a collaborative pedagogical effort. For example, non-formal educators often possess more extensive and in-depth experiences with a particular place and context and the specifics of environmental

concepts as they play out in a given context, while formal educators often possess a more extensive understanding of their students' past experiences and prior knowledge that can serve as an equally valuable learning resource (Kisiel, 2010).

The interdisciplinary nature of non-formal science education reflects the idea that science knowledge is intertwined with many different subject areas. It is a popular misconception that environmental educators are non-formal because they are usually not employed by a school and can hold a variety of job responsibilities within a community. One of these responsibilities is going into schools to offer short programs related to particular curricula - most often science or social studies. Environmental education (EE) can provide the context for the hybrid approach described by Hofstein et al. (1997) whereby non-formal education enhances formal science education. The Tbilisi Declaration of 1978 defined one of the goals of EE as fostering awareness about ecological interdependence through the acquisition of knowledge, values, attitudes, commitment, and skills to protect the environment (UNESCO-UNEP, 2005). Embedded within this goal is the standards-based curriculum of ecological concepts within science education, as well as instrumental affective factors often honed through non-formal EE. EE can play a versatile role in curriculum as it lends itself to interdisciplinary instruction and can facilitate connections between non-formal and formal classroom instruction. Tal (2004) notes the very nature of EE focuses on local, socio-scientific issues and affords the opportunity to build partnerships between schools and communities (p. 3).

Our study seeks to explore how to intentionally and effectively structure the partnership of a formal and non-formal educator. Even less well known than how non-formal education is woven into formal education is how classroom teachers and non-formal educators work together to plan and implement these kinds of partnerships in the classroom. It is this gap in the literature that our study addresses and in so doing, we assisted in and investigated the partnership between a fourth grade classroom teacher (Sarah) and an environmental community educator (Elizabeth) to implement an environmental stewardship program based on local ecology. In particular, we were interested in exploring the role each educator assumed in the partnership and the nature of the partnership in relation to the intended goals for the curriculum. Our research question asked "What were the respective goals and perceived roles of a classroom teacher and a non-formal educator in a collaboration to teach students about environmental stewardship?"

2. Literature Review

The following is a review of literature related to incidences where formal and non-formal educators communicated and collaborated. Though research regarding the collaborations between formal and non-formal educators is scant, some evidence does indicate the mutual benefit to partnerships in terms of enhancing pedagogical repertoires and bringing together of different funds of knowledge for the benefit of the students.

2.1 Formal and non-formal partnerships

Non-formal science instructional strategies can provide a variety of learning contexts that may or may not be utilized in the formal setting (Ruiz-Primo, 2006). Many classroom teachers unfortunately underutilize non-formal science teaching strategies. Rennie (2007) notes that the effectiveness of non-formal science education experiences often depends on how well they fit the school science curriculum. She also states that many non-formal science experiences, most

notably school field trips, are often not integrated well or at all with work done in the classroom. She acknowledges the need for research that investigates teachers' use and integration of "the wealth of resources available beyond the classroom door" (p. 155).

Given the assumption that teachers can learn a great deal from one another, one would assume that formal educators could learn a great deal from instructional strategies traditionally used by non-formal educators and vice versa. In fact, Kisiel (2010) found that the development of intersecting communities of practice between formal and non-formal science educators led to new perspectives and insights for both groups. In his study, classroom teachers re-examined their instruction and developed an appreciation for hands-on learning, while aquarium instructors better understood the challenges and benefits of working with students on a long-term basis.

Dori and Tal (2000) investigated the integration of formal and non-formal science pedagogies through a collaborative community project. Their instructional model included classroom instruction, parental involvement via out-of-class meetings and discussion sessions, field trips, and outside research conducted by the students. While the focus on their article was on assessment of formal and non-formal science programs, they found that the combination of formal and non-formal learning resulted in increased environmental attitudes and knowledge and provided an attractive learning format for students.

Regarding pedagogical differences, Astor-Jack, McCallie, and Balcerzak (2007) found that approaches to educator professional development (PD) differed according to the sponsoring institution. Institutions of higher education focused on research-based strategies, the needs of the teachers, cognitive approaches to teacher change, the views of their funding sources, and understood inquiry as both a research strategy and something that scientists engage in to *do* science. On the other hand, institutions of non-formal science education focused on the strength of materials and hands-on approaches to teaching science, the PD features that their institution found vital, increasing the comfort level of teachers when teaching science, and inquiry a means to engage students and teachers in learning science.

Astor-Jack et al.'s (2007) study demonstrated the dichotomy between formal and non-formal science educators, which may underscore the image that formal and non-formal approaches to science differ. Instructional strategies that incorporate both the formal and non-formal philosophies of teaching may benefit students, however the current dichotomous perspective may not allow for collaboration and mutual understanding between the two. Perhaps the issue lies within the diversity and complexity of non-formal science education, as it encompasses a variety of settings while research suggests that these settings are not equal in their abilities to support science learning outside of the classroom.

Many models of integrating non-formal with formal science education exist (DeWitt & Osborne, 2007; Hofstein, Bybee, & Legro, 1997; Orion, 1993). These models have been investigated for their effect on science knowledge, learning, and attitudes. The studies reviewed here suggest a teaching orientation that involves the combination of non-formal and formal science instruction promotes science learning (Hofstein et al., 1997) and the goals of scientific literacy as defined by the *National Science Education Standards* ([NSES], NRC, 1996). One of these goals is to "experience the richness and excitement of knowing about and understanding the natural world" (NRC, 1996). Smith-Sebasto and Carvern (2006), Dori and Tal (2000), and Stern, Powell, and Ardoin (2008) all found that the integration of non-formal and formal science met this goal as it increased positive attitudes toward science and the environment. For example, Smith-Sebasto and Cavern found that students who participated in residential environmental experience had a higher concern for the environmental when their teacher engaged them pre and

post activities in the classroom, and Stern et al. (2008) found that a residential environmental education program increased students' connection to nature.

3. Methodology

The following sections describe the participants, context, and research methods we used to explore the goals and perceptions of roles with Sarah and Elizabeth.

3.1 Participants

For the past eight years, Elizabeth had been the education director for a local solid waste management district. She held a bachelor's degree in Journalism and had no formal pedagogical training in education. As a long-standing non-formal educator in the community, she was frequently petitioned by teachers to guest speak in their classrooms about issues concerning waste reduction through recycling and composting, ecological concepts related to the local community, and environmental stewardship. In her office at the solid waste management district, Elizabeth had many "tools" such as posters, games she had developed, and toys with which to engage elementary students in the concepts of environmental education.

Sarah, the formal fourth-grade teacher in our study, had more than 20 years of teaching experience across various elementary grade levels and held a Master's degree in Education. She had taken no additional science content training since her original undergraduate degree and often described herself as limited in science knowledge. In fact, for several years, Sarah had allowed another fourth-grade to instruct the students on science while she taught them math- a subject with which she felt more comfortable. Sarah had invited Elizabeth to her class as a guest speaker on many occasions, enjoying exposing her students to the environmental science concepts about which Elizabeth taught them.

Both teachers had worked together many times in the past, but mainly in the form of Elizabeth coming into Sarah's class to give a one day discrete lesson on a particular concept. Sarah would choose from among Elizabeth's one-hour programs, attempting to give her students a broad array of concepts Elizabeth had to offer. Neither of them had been involved in an extensive teaching partnership as described below in this study, but both expressed interest in extending the offerings to Sarah's classes to incorporate a sequenced program throughout the semester in which ecological concepts built upon each other to encourage students understanding of environmental stewardship.

To support the development of this partnership, both authors (science educators working at a local University, both of whom possess PhDs in science education and are former classroom teachers with a particular interest in non-formal and environmental education) worked with Elizabeth over the summer to co-plan a six-week unit for Sarah's classroom (described below). Elizabeth had approached one of the authors at a environmental education conference earlier in the summer asking for assistance in ensuring her programs were well aligned with curriculum goals and wanting to incorporate some guided inquiry so as to encourage students to apply what they were learning in her programs in some sort of culminating project. Authors provided Elizabeth with advice and guidance throughout the design and also during the implementation of the instructional program and participated in debriefing sessions with both Elizabeth and Sarah

after each class session to help make modifications to future lessons throughout the implementation of the unit.

3.2 Context

The school where this study took place was a K-12 Christian academy located on the periphery of a Midwest college town of approximately 70,000 people. Sarah taught a fourth grade class with 21 students: two Asian Americans, one African American, and 18 Caucasians. The majority of these students came from medium to high socioeconomic households located either in the rural surroundings of the school or directly in town. Sarah was responsible for teaching most subjects throughout the day and one hour of instructional time was devoted entirely to science each day but usually was taught by another teacher in the school.

The unit we designed in collaboration with Elizabeth was composed of six instructional sessions on various topics related to fourth grade science standards about ecology, environmental education, inquiry, and the nature of science. Table 1 highlights the main goals, roles, and activities for the six continuous sessions. The unit was designed for implementation over a six-week period and resulted in a culminating project whereby students showcased what they had learned and what was most important to them in the five preceding programs. Students were asked to create a medium of their choosing (brochure, game, skit, poster, etc...) to illustrate the science concepts they learned and discuss what people should know regarding environmental stewardship. Parents and local media were invited to and attended the culminating projects.

Table 1.
Sequential program for environmental stewardship*

Lesson/Topic	Goals	Activities
1 – Environments	Students learn about interconnectedness, balance, and ecosystems	• Discussion of cycles (carbon cycle, water cycle, recycling symbol) • Ecosystems • Food chains & webs • Human knot activity • Read “Tinker’s Clock” story
2 – Home and Community	Students gain sense of place and learn about healthy communities Students understand life is all around us, life needs to be protected, healthy communities need a variety of natural habitats	• Requirements for life • “Milky Way” poem • Discuss history of development of land in their community • Student draw their own backyard or “place” • Students make suggestions for making their “place” healthier • Read “Window” (by Jeannie Baker) book
3 – Household Hazardous Wastes (HHW)	Students identify source of everyday hazardous materials	• Students identify hazardous materials in their homes and backyards • Discussion of HHW • Toxic trash quiz • Students create own non-toxic natural cleaning solutions (all-purpose cleaner and furniture

		polish)
4 – Perspectives on Trees	Students are exposed to multiple perspectives of an issue Students understand the complexity of environmental issues Students explore "rewilding" their yard	• Read "Growing Wild" (by Constance Perenyi) book • "Tree Perspective" debate (three perspectives of development: none, partial, and full) • Students rewild their yards • Students brainstorm ideas for culminating projects
5 – Power of One	Students recognize the effect one person can have on protecting the planet Students learn about recycling	• Song, "Who Made This Mess" • Discussion about challenges to waste management • Smart Shopper game (students choose environmentally friendly purchases) • Kinesthetic exercise to learn how to recycle materials
6 – Culminating Projects	Students share their content knowledge with others	• Parents and local media were invited to culminating project presentations

* Sessions begin with large scale (environment, ecosystem level) to smaller scale (personal level)

3.3 Research Methods

Our case study utilized a qualitative research approach (Bogdan & Biklen, 2003; Creswell, 2003) and was aligned with socio-constructivist perspectives on human interaction (Robson, 2002). Thus, the focus departed from taking face value of the verbal understandings of the participants in order to probe for and discover the actual 'experience' and the issues that emerged from the differences in those experiences. Patton (2002) stated that case studies are used when ''one needs to understand some special people, particular problems, or unique situation in great depth…'' (p. 54). We sought to understand how two teachers collaborated (or did not collaborate) in a formal-non-formal science education partnership and aimed to redraw generalizations within this area. The phenomenological orientation of our case study indicated our privileging of participants' first-hand experience of the phenomenon (Merriam, 2009).

Considering this approach, we employed open-ended data collection methods that included video and audio recordings of the classroom instruction, debriefing sessions with both teachers following each day of instruction, researcher journals that documented our impressions of what we observed and our conversations with both educators, and a pre and a post semi-structured interview with each educator (four total). Interview questions included: (a) How do you view the collaboration between a non-formal and a formal educator? (b) What challenges are there to bridging formal and non-formal education? (c) What benefits are there to bridging formal and non-formal education?

We analyzed all data sources using an inductive approach commonly employed in qualitative research. Thus, we reviewed the data looking for emerging themes in relation to our

research question, and in particular with respect to the participants perceived and implemented roles in the teaching partnership and the effect of their intended goals on the nature of this partnership. After reaching a point of saturation in identifying themes related to each of these objectives, we then looked for patterns related to these themes across multiple data sources. As a validity measure, we conducted member checks with both educators after developing our initial findings to ensure our interpretations were accurate and hone inferences drawn from our multiple data sources.

4. Findings

A number of themes emerged from the data related to how Elizabeth and Sarah viewed their roles in the partnership. Both educators appeared to have different goals, as well as different perceptions of their roles; as such, we identified several obstacles that complicated the partnership.

4.1 Different Goals

Sarah and Elizabeth's goals for the series of programs related to environmental stewardship differed in many respects. Sarah supported environmental behavioral goals through the context of learning science that was supplemental to the curriculum, while Elizabeth focused solely on affective (i.e., behavioral and attitudinal) goals towards building environmental stewardship. Given her extended experience as an elementary teacher, Sarah had previously invited Elizabeth into her classroom a number of times prior to our study to enrich the curriculum and encourage students to consider their behavior with regard to their environment. In her pre-interview, she shared her prior experience with Elizabeth:

> I think she gets them thinking about a lot of things that maybe they hadn't thought about before, like recycling, taking care of the water, being careful it's not contaminated. Kids think that it doesn't really apply to them. She lets them know that there are things they can do and they become more aware of things and they can share it with their family. (pre-interview, January 2009)

Sarah's perception of Elizabeth's role in the classroom was about encouraging students to take action and to bring what they were learning back to their families to encourage more environmentally responsible actions. She saw Elizabeth as being a message-bearer of sorts regarding the importance of student awareness for local environmental health.

Sarah understood the value of EE but often referred to it as enrichment. For example, she made statements like, "I didn't do a whole lot of before and after, I think I treated it more like an enrichment thing that they would look forward to and she'd come and present something and then we'd be on to the next thing" (pre-interview, January 2009). As such, Sarah initially saw Elizabeth's programs as an enhancement to her classroom instruction and did not ask or expect Elizabeth to cover specific content. She clearly stated that she requested Elizabeth's programs for enrichment purposes without planned or deliberate engagement in any in-depth follow-up activities with students. She viewed her students' time with Elizabeth as a break from the regular routine and seemed to feel that the sessions were valuable enough to schedule an average of six

hour-long sessions with Elizabeth per year, despite her view that the sessions were solely for enrichment purposes.

Over the course of the collaboration, however, Sarah's view of Elizabeth's role changed. While Sarah initially viewed the purpose of having Elizabeth in her class as a means of enriching the students' learning of science, in her post interviews at the end of the six-week program series she revealed that her goals were not satisfactorily met. The importance of environmental science content increased from Sarah's pre to post interview. Initially, she felt that the enrichment that Elizabeth provided was sufficient reason to schedule her programs; however, in her post interview she seemed dissatisfied with the lack of content covered. In discussing her goals for student learning, Sarah repeatedly noted the importance of having her students learn science content (or "facts") with affective outcomes as an added value:

> I don't know, I've gone back and forth about this in my mind, and I don't know, I mean, [the programs and culminating project] were like eight hours because I gave them a couple more hours, and I keep thinking in the project it didn't come out that they learned very many facts. (post-interview, April 2009)

Sarah felt that the students' culminating projects did not reveal adequate content knowledge learned during Elizabeth's programs; however she was uncertain if this was due to a lack of actual content learning or to the lack of focus and support given to the students to create projects that demonstrated their understanding. We acknowledge that our presence and interest as researchers may have influenced how Sarah perceived the value of Elizabeth's programs in her classroom. Because we inquired about her views on the curricular alignment of the programs, it is probable that Sarah came to see this as important to address. It is equally probable that the addition of the culminating project enabled Sarah to see for the first time in the program involvement what the students were actually learning and/or finding valuable from the programs.

As the education specialist of the local solid waste management district, Elizabeth's job was to encourage responsible action with regard to community waste and protection of the environment. She expressed this in her pre-interview: "EE is a practical application and there are a lot of principals to life, and it is interdisciplinary...it supports behavior change" (pre-interview, January 2009). Prior to the implementation of the curriculum, Elizabeth, like Sarah, viewed her programs as an addition to the regular curriculum and not necessarily aligned with specific content standards. Though this study was initiated in part by Elizabeth's desire to base her programs in state content standards, she perceived her goals to be centered on inspiring behavior change.

However, by the end of implementing this six-week unit, Elizabeth said she valued the importance of basing her programs in state content standards and in particular, she appreciated our guidance in making these connections within her existing programs.

> I think it was really helpful to have you two here to go through those [standards], because I have looked at them before and they are so general to me that they didn't mean much. But the food chain, the food web, I think that worked out really well, and after we had worked on it, and we inserted more stuff in that next session and elaborated on it, I think it worked out well, and I was pleased. (post-interview, April 2009)

Elizabeth was eager to incorporate more science content and felt that her programs successfully addressed state standards. She felt students were more engaged when she was teaching content. She also saw the potential in this leading to more requests from teachers to do her programs in their classrooms and seemed excited about including more content in her programs, although she was not completely confident in her own abilities to do so. She expressed the need for continued support from researchers, like us, who had experience with designing content-rich curriculum. It is important to note that Elizabeth's embedding of content may have been done simply for legitimizing her place in a curriculum and not because she valued or understood science teaching or learning in a more nuanced way because of the experience.

Whatever the cause for both educators to come to place a greater emphasis on the incorporation of science content standards, the degree to which they viewed the programs as successful was notably different. Sarah clearly saw opportunities for vast improvements in the unit with regard to content. She saw potential within the revised programming framework to reinforce science content, but reflected on the need to provide more guidance to the students so that they could demonstrate their learning more so than merely their affective gains regarding environmental stewardship. Elizabeth, on the other hand, was pleased with the level of science content embedded within the unit and felt future programs could benefit from the addition of more science standards- an indication that being able to connect her lessons to standards on paper was adequate. While both educators' goals evolved to include not only affective outcomes but also increased science content, the perception of the success of these goals differed greatly between the two participants.

4.2 Perception of Roles

Sarah and Elizabeth's perceived roles in the unit also shifted before and after the six-week program. In effect, at the end of the unit, Sarah placed a higher value on her own involvement with the implementation of the unit, and Elizabeth perceived her role as more of a traditional teacher with regard to classroom management and teaching content.

Prior to Elizabeth's programs, Sarah identified that she did not feel teaching science was her strong suit. Her students went to another classroom during their science hour; therefore Sarah did not feel it was her responsibility to teach science. As a result, Sarah said she did not know much about the content or the organization of the science curriculum:

> The third grade teacher will come in and teach while I go over and teach the third graders social studies, just because science is her strong area and social studies is mine…so I know that the book is supposed to be aimed at the standards, both state and national, but I don't know [about science content standards]. (pre-interview, January 2009)

Therefore, she left the responsibility of teaching science to her colleague and as stated above in the past did not expect Elizabeth to 'cover' science content with her programs, but saw her role as simply providing science enrichment. However, by the end of the six weeks, Sarah became more interested in thinking about ways Elizabeth's programs could be more than just enrichment and instead actually designed to support students' learning of particular environmental science content standards. Her perception of her own role in the process changed, which was evident from the following comment she made:

> [If Elizabeth could provide] something that could give the kids feedback on [what they learned], if she made it up to go along with what she thought were key things that she had taught and left it with me, I would be glad to see that we reviewed a little bit. I could then see if they were picking up everything they were supposed to be picking up. (post-interview, April 2009)

Gradually, Sarah took on a more active role in the implementation of the unit. When asked about this, she responded that part of the reason for this change was that she needed to hear what the students were learning so that she could reinforce concepts later. She attributed this partly to the program format that incorporated a culminating project to showcase what the students were learning:

> Yeah, I think knowing that it was going to culminate in these projects, normally when she comes in, it's just kind of a time that you set aside where she works with children, so knowing this is coming, you get a little more focused and engaged, like 'what are they doing?' (post-interview, April 2009)

Because the programs were leading up to a chance for students to display their content and/or affective gains, Sarah's perception of her role as a science teacher made a distinct shift as she came to appreciate the need for her to take on a more active role of reinforcing concepts and probing students to investigate deeper into their questions regarding ecological concepts. Furthermore, knowing that parents and local media were invited to the culminating event, an additional pressure for students to perform was instrumental in her involvement.

Elizabeth's perception of her own role also evolved throughout the study. She initially did not recognize the need to engage in classroom management strategies, noting that it was the classroom teacher's responsibility to ensure students were paying attention and participating. However, from our classroom observations during the beginning sessions, we noted Elizabeth mostly lectured to the students and in turn the students often seemed disengaged. Therefore, during the debriefing sessions, we offered Elizabeth suggestions on how to engage students and grab their attention. Over the course of the program offerings, we began to see her employ the strategies we mentioned (e.g. probing questions, extensions to content elicited from the students about their daily lives, minimizing transition times, and basic management techniques). At the end of the implementation, Elizabeth said hearing these suggestions really helped her think about how best to present content to the students from session to session:

> I learned to reinforce the concepts in each session, [through] repeating [or] emphasizing the terminology. I also picked up disciplinary [strategies]. Although the teacher was usually right there and could just step in, I at least know [some different strategies] because every situation is different. (post-interview, April 2009)

Additionally, Elizabeth's perception of her role to teach science content developed over the course of the study. While initially stating that her goal was to teach students about environmental stewardship, in her post-interview she suggested the importance of also including content standards in her programs. Although this shift was described above in terms of Elizabeth's changing goals, this awareness of incorporating more standards in her programs illustrates a shift in her thinking that as a non-formal educator as well; specifically, that her role

is not to just influence students' affective domain but also to engage their cognitive domain. As mentioned above, Elizabeth believed including both foci in her programs may make them more desirable to other teachers, but furthermore, her quest to develop her skills as a classroom teacher by way of enhancing her classroom management and content delivery skills became increasingly evident.

By the end of the unit, Elizabeth stated that she needed to go into classrooms thinking about what content she can address in an already over-burdened curriculum. She acknowledged that teachers have varying expertise and comfort regarding science and saw her potential role as addressing content as a means to lessen the need for the classroom teacher to teach it all. In attempting to do so, she perceived this role as necessitating a more collaborative partnership with the classroom teacher with regard to both planning and implementation.

> I learned that if I do it this way, the [classroom teacher] will maybe get more into it and maybe think of some other ways that they can do things in their classroom to perhaps extend the curriculum. (post-interview, April 2009)

From her experience working with Sarah in this study, it appears Elizabeth recognized the need to clearly state her needs and expectations to classroom teachers, as well as to take the time to listen to their expectations for increasing the value of her programs into their classrooms.

5. Discussion and Conclusions

Elizabeth and Sarah's experience illustrates how perceptions of learning goals and individual roles in the partnership can evolve through a guided collaborative experience. For example, both Sarah and Elizabeth changed their perspectives and expectations of the programs to ascribe an increased importance of programs being aligned with state science standards. As noted above, prior research suggests that non-formal education can promote positive attitudes and confidence in science (Kelly, 2000), scientific reasoning (Gerber, Cavallo, & Marek, 2001), and interest in science, (Zoldosova & Prokop, 2006); however, scant research was found that indicated the extent to which science standards are generally covered by non-formal science programs. This remains an underexplored area, and we would like to continue our efforts in investigating the extent to which an increased content base actually enhances formal and non-formal partnerships as well as student outcomes.

This lack of research may suggest that there is no clear expectation with regard to coverage of science standards in non-formal education. Sarah felt that there were not enough "facts" learned during the programs, which suggests that her expectations rose from enrichment to an increased emphasis on reinforcement of science content. She seemed to think the time dedicated to Elizabeth's programs was no longer "worth the sacrifice" if content was not adequately embedded. Elizabeth, on the other hand felt pleased with level of content covered in her programs after we collaboratively worked with her to format her programs to incorporate state content standards. She thought she was providing elementary teachers what they wanted and that her programs were an effective in teaching her newly formed goals of both environmental stewardship and science content.

The disparity between the educators' perceptions of their goals indicated that more of an effort ought to be made to incorporate more pedagogical content knowledge within the training

of non-formal science educators. Pedagogical content knowledge includes an understanding of what makes the learning of specific topics easy or difficult, as well as the conceptions and preconceptions that students of different ages and backgrounds bring with them to the learning of those most frequently taught topics and lessons (Shulman, 1986). Many museums, zoos, and science centers have educational outreach arms that understand and respond to local curricula (Stocklmayer, Rennie, & Gilbert, 2010). The non-formal sector must target outreach activities to the requirements of the curriculum and ensure that those involved in providing science outreach are suitably trained and qualified to do so. As Astor-Jack et al. (2007) indicated, professional development for non-formal educators often focuses on materials and the development of resources related to their area of expertise, though we suggest that an increased emphasis be placed on underscoring the aims of teachers regarding the delivery of standards-based content and classroom management best practices.

Therefore, we suggest organizations coordinate with schools to discuss the mission and goals of their respective institutions to support the joint achievement of desired outcomes. Elizabeth clearly stated that her goal was to increase environmental stewardship, while Sarah's began to expect more science content in the programs. Perhaps there is a way to address both of these objectives simultaneously. The questions remains, however, how do institutions develop what Shulman (1986) described as *specialized knowledge* teachers have for knowing how to teach specific topics in various ways to different learners (i.e., pedagogical content knowledge)? This is another avenue to explore related to enhancing non-formal and formal partnerships.

Both educators' perceptions of their roles in teaching the curriculum also evolved over the course of implementation. While initially thinking she should leave all instruction related to the science content standards to her third-grade teacher colleague, Sarah became aware as the program progressed how certain environmental concepts could perhaps be covered using Elizabeth's curriculum, rather than it just being a supplement or enrichment program. Therefore, each week she gradually became more involved in the actual instruction of the curriculum, feeling accountable for helping the students with completing the culminating project as designated by the curricular design. By the end of the study, Sarah's perception of Elizabeth's role also changed as she noted that an emphasis on covering more science content Elizabeth's programs could be a core piece of their overall science curriculum; however, she also noted that Elizabeth would need to make some modifications to her current programs to better meet these expectations.

Perhaps, a nexus point for the development of this type of collaboration lies in the inclusion of formative assessments throughout non-formal education that is conducted within classroom settings. Formative assessment is any pedagogical activity intended to scaffold learning and inform instructional decision-making. We draw on Ruiz-Primo and Furtak's (2006, 2007) characterization of formative assessment, which they generally divided into two types; namely, formal, planned formative strategies and informal, interactive ones. Formal, planned formative assessment is designed in advance by the teacher and requires all students to respond to a prompt or complete an activity. The outcomes of student activity allows teachers to precisely gather data on each student's learning and allows teachers to check student understanding at key points during instruction so as to thoughtfully plan the next steps in instruction. Informal, interactive formative assessment, on the other hand, is more improvisational in nature, is often linked to the instructional strategy or learning activity at hand, and allows the teacher to adapt instructional strategies immediately.

Due to the feedback loop associated with formative assessment, non-formal and formal educators would need to work together to collect, interpret, and modify instruction based on student feedback. This would not only provide students with the feedback needed to improve their learning of the content and affective gains, but also encourage the type of continual reflection we aimed for in this guided collaborative experience. With respect to this, research shows the kind of evaluation that goes on in non-formal programs is inconsistent and variable. Rennie (2007) stated, "despite the availability of good advice, most evaluation [of school-community partnerships] is usually limited to feedback sheets and headcounts of participants," (p. 146) and that evaluation of non-formal programs is often influenced by the agenda of the funding agency. Alternatively, we suggest a more robust and dynamic partnership between formal and non-formal educators that would necessitate working together both prior to and during the implementation of programs to define goals and iteratively gauge roles of each educator in the process.

Our exploration of a partnership between a formal and a non-formal educator revealed that their perceptions of goals and roles differed. Therefore, the question remains: Should we find ways to promote collaboration to develop overlapping goals between formal and non-formal educators, or are their educational aims inherently different? Should non-formal programs be incorporated into classrooms as enrichment, especially in light of recent cuts to school budgets that remove opportunities for field trips? Is the impact they are making sufficient while concentrating on their unique goals? The results of our study indicate that formal and non-formal educators can support one another's goals through systematic collaboration. However, future research needs to explore the impact of explicit collaborations that include direct attention to aligning goals for learning with specific content standards, affective outcomes, and clarifying teachers' roles in this process. Both educators must be made aware of the commitment involved in an explicit collaboration, including materials needed, expected levels of communication, individual roles, assessment aims, and time needed for effective outcomes.

The main scholarly implication of our work is the need for educational researchers, both in non-formal and formal education, to attend to the collaborative dimensions of formal and non-formal partnerships. Previous research has focused primarily on the cognitive and affective outcomes of programing and the various challenges of embedding non-formal education within classroom settings. However, the maximize the benefit both to students and to partnering educators, the dynamics of these collaborations offers a chance for teachers to establish and sustain a social matrix within which meaningful discussions about goals and definition of roles becomes possible.

Despite its practical and scholarly significance, we would like to note various limitations of this study. Because of the limited scope of our case study focusing only on one collaboration, many relevant issues remained unaddressed in our exploratory analysis of formal and non-formal partnerships, including the extent to which the strategies reported in this study can be effectively and appropriately adopted by teachers to facilitate effective partnerships across varied education contexts and how teachers' collaborative practices impact learning outcomes (e.g., students' conceptual understandings of ecological concepts, affective views of environmental stewardship). Additional studies will be necessary to explore these aspects of formal and non-formal partnerships.

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