

Environmental Education in Action: How Expeditionary Learning Schools Support Classroom Teachers in Tackling Issues of Sustainability

By Meg Riordan & Emily J. Klein

Introduction

“Change begins because of you!” read a calendar urging action to end pollution to the Chesapeake Bay. Created as a final product by a group of Expeditionary Learning School teachers engaged in a professional development experience, the calendar synthesized one-week’s worth of immersion in learning about human impact on the Chesapeake Bay Watershed. These science and math teachers engaged in water testing, interviewed experts, and conducted fieldwork to investigate environmental issues and propose solutions. Some produced public service announcements, restaurant place-mats, “harbor bands”

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(a variation on Silly Bandz, with shapes like crabs, rockfish, and bottles), and the calendar above. The teachers’ enthusiasm was palpable; they were proud of their work and of their knowledge in spreading a message of environmental action. The real power, one teacher expressed, “is in taking this back to my own classroom so that my students feel the way that I do right now.”

As the anecdote above illustrates, the environmental education (EE) movement has much to contribute to educational reform and more specifically, to how we construct effective teacher professional develop-

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ment. Literature about environmental education defines it in multiple ways, and for the purposes of this research we understand EE to be a collaboration of content and pedagogy that engages students in a study of the environment to “encourage behavior change and action” (Thomas, 2005). Fundamental to EE are pedagogical methods that include: hands-on activities, relevant subject matter, and topics that engage students and encourage participation. Education reformers recognize EE as an effective tool in capturing students’ enthusiasm for learning in subject areas ranging from math and science to literature (Lieberman, 1994). Research also indicates that EE promotes the following qualities in students: critical thinking, problem-solving, leadership characteristics, high academic engagement, and healthy lifestyles (Archie, 2003; NAAEE, 2001).

Environmental education pedagogy is grounded in a view of teaching as a “creative and dynamic process in which pupils and teachers are engaged together in a search for solutions to environmental problems” (<http://unesdoc.unesco.org/images/0010/001056/105607e.pdf>). However it is not only the students who need support engaging in this search but the teachers—in creating dynamic, rigorous exploration of environmental issues. Ian Robottom (1987b, 1987c, 1987d) promotes professional development to support teachers’ pedagogical approaches to EE, which differ from traditional teaching approaches. These include interdisciplinary planning, active investigation of local issues, and robust participation—with students—in activities around environmental improvement.

Research about professional development in environmental education indicates that it can bring about significant shifts in teacher thinking about environmental issues (Shepardson, Harbor, Cooper, & McDonald, 2002). A recent study (Fleming, 2009) identified key areas of need for professional development in environmental education; among these are: involving communities in environmental and health initiatives, networking opportunities for teachers to share best practices, strategies and techniques for teaching students critical thinking skills, and integrating EE into K-12 curriculum.

However, many teachers, while interested in engaging students in EE, struggle with successful integration, whether in the classroom or in connecting students to out-of-classroom fieldwork opportunities (Barnett, Lord, Strauss, Rosca, Lanford, Chavez, & Deni, 2006; Orion, N., & Hofstein, A., 1994; Shepardson, Harbor, Cooper, & McDonald, 2002; Simmons & Young 1993; Young & Simmons, 1992;). Also, there is little research about how teachers develop and implement curriculum or use materials from professional development experiences.

This study looked at the work of an organization that strives to support teachers in developing environmental education that “promote[s] the development of responsible and active citizens who are invested in environmental issues and situations, and who are empowered by their ownership of knowledge and skills” (Hugerford & Volk, 1990).

Expeditionary Learning Schools

Expeditionary Learning Schools (EL) is a national education transformation organization that partners with new and existing schools—elementary, middle, and high—in urban, rural, and suburban areas. EL works with over 150 schools to increase student achievement, promote strong culture and character, and deepen teachers’ practices: “The ELS approach promotes rigorous and engaging curriculum; active, inquiry-based pedagogy; and a school culture that demands and teaches compassion and good citizenship” (www.elschools.org). At the core of EL’s curricular model are learning expeditions, which are interdisciplinary, in-depth investigations of topics grounded in state standards.

Rooted in ideas of progenitors such as Kurt Hahn, John Dewey, Howard Gardner, and Eleanor Duckworth, EL grounds environmental education in its ten design principles, one of which is “The Natural World.” This principle asserts: “A direct and respectful relationship with the natural world refreshes the human spirit and teaches the important ideas of recurring cycles and cause and effect. Students learn to become stewards of the earth and of future generations” (www.elschools.org). This principle, in conjunction with the others (such as “The Responsibility for Learning” and “Service and Compassion”), articulates the core values of EL, shaping school culture and creating a solid moral purpose for teachers and students.

Organizationally, EL strives to meet the needs of EE professional development identified in Fleming’s (2009) study above. Professional development institutes incorporate opportunities for teachers in the national network to share practices; facilitators demonstrate ways to incorporate EE into science and other content areas across all grade levels (through sharing expedition templates), school coaches (called school designers by EL) model practices to teachers that promote students’ critical thinking skills, and EL supports teachers in structuring out-of-classroom experiences that bring students into the community, inspire interactions with local experts and culminate in presentations to authentic audiences.

EL offers all newly hired teachers a two-week-long introduction to its—expeditions, and promotes hands-on, experiential learning through content-based professional development (Klein & Riordan, in press). The professional development places teachers in the role of learners, providing an opportunity to experience compelling topics, active pedagogy and literacy strategies, hands-on fieldwork, conversations with experts, and creation of products (all components of expeditions). In debriefing the professional development, facilitators try to help teachers step outside of the learner role to unpack and reflect on experiences in order to transfer and apply their learning to their own classroom practice.

This research explores environmentally sustainable school practices through a case study of how one school design, Expeditionary Learning, provides teacher professional development. This professional development promotes environmental-based education that aims to support teachers in learning and teaching about ecosystems and the natural world and has as its goal an impact on student experi-

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ence and work. Embedded within this study, and the focus of this article, are two case studies of teachers in urban schools developing and implementing science expeditions, a primary pedagogical practice in the EL school design. The goal of both expeditions was to engage students in exploring ideas of sustainability within their communities, families, and the larger world.

We asked the following:

1. How does EL provide teachers with experiences to develop the knowledge and skills needed to engage in activities associated with environmentally sustainable practices?
2. What impact did EL professional development have on teachers' curriculum and instruction in environmental education? On students' experiences and work?

Theoretical Framework

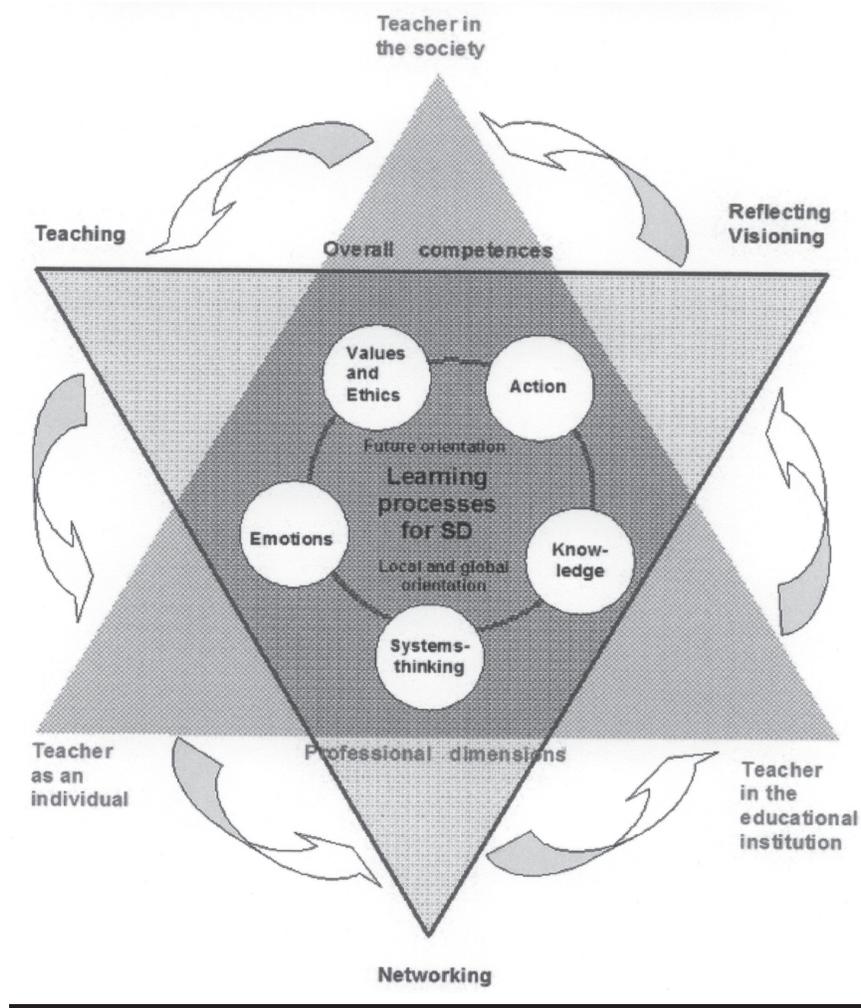
Our theoretical framework is informed by two strands. Both frame professional development through the construction of learning experiences for teachers. The first emerges from Darling-Hammond and McLaughlin's (1995) research on teacher professional development, which lauds "learner-centered professional development which involves teachers as active and reflective participants in the change process" (p. 597). The authors suggest effective professional development reflects the following characteristics: (1) opportunities for teachers to engage in hands-on tasks; (2) a foundation in inquiry, reflection, and experimentation; (3) collaboration; explicit connections to classroom teaching and students' learning; and (4) provides on-going support and coaching. This research offers a construct for the design of teacher professional development and what such teacher-engagement might look like in practice. It connects directly to Expeditionary Learning, which offers professional development that "emphasizes active teaching and learning" (<http://elschools.org/design/index.html>).

The second strand of our theoretical framework borrows from the Curriculum, Sustainable Development, Competences, Teacher Training (CSCT) project (2008) which offers a curriculum model to support teacher professional development that integrates environment education for sustainable development into their curricula. This model (See Figure 1) envisions the teacher's professional role as less "communicator of knowledge" and instead as an individual "in a dynamic relationship with their students, their colleagues, and the wider society" that is "confronting issues of sustainability" (p. 27). To do so, particular competencies are needed: knowledge, systems thinking, emotions, ethics and values, and action. Those competencies are further influenced and informed by another layer of skills, including "teaching, reflection, and networking" (http://www.ensi.org/mediaglobal/downloads/Publications/303/CSCT%20Handbook_11_01_08.pdf). The relationship between the

professional dimensions and competencies offers us a dynamic lens through which to examine how teachers create interdisciplinary studies, formulate their curricular visions of EE and sustainability, foster networking opportunities, and orient students to local and global issues.

The two aspects of our theoretical framework are tightly linked. We locate professional development as defined by Darling-Hammond and McLaughlin within the context of CSCT's model on teacher learning, competencies, reflection, and networking. *What* teachers learn (the CSCT competencies) and how it plays out

Figure 1
Dynamic Model for ESD Competencies in Teacher Education



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in their classrooms, schools, and society *matters*. We use Darling-Hammond and McLaughlin's research to make sense of *how* that teacher-learning occurs.

Methods

This study uses qualitative case study methods as a means of focusing deeply on the learning experiences of two teachers within an organization. It allowed us to look at ways their professional development experiences influenced observable classroom work and developed curriculum. Case study methods allow for a close examination of the multi-faceted experiences of a single instance (Stake, 1997), which seemed particularly important in answering questions that tried to trace the influence of professional development through teachers curriculum design to classroom practice and student experience. Case studies also make use of direct observation and systematic interviewing, which allowed us access to professional development experiences, teacher classrooms and to the teachers themselves (Yin, 1994). This particular study focused on two Science teachers in Expeditionary Learning Schools in a large Northeastern city.

Setting

We explore two EL science classrooms engaged in environmental education-focused expeditions. A 7th grade science classroom studied the guiding question, "What Sustains Us?" through a case-study investigation of food, farms, and community gardens. A 9th grade science class engaged in an expedition titled, "Survival in the City," and considered "the value of resources" and "why water is critical for life." The 9th grade class's expedition served as the foundational experience that further launched a whole school initiative to target student and community health through raising awareness of "urban food deserts," planting a school-garden, and partnering with local organizations to promote and sustain access to healthy food.

Participants

Participants were two EL Science teachers working in urban public schools; one is male and the other female, and both are in their mid-30s. Wendy has been teaching since the late 1990's, and Lee has been teaching for six years.

Wendy. Wendy graduated from college with a degree in nutritional science and shortly afterwards joined the Peace Corps. Upon returning from abroad, she was invited to join a Peace Corps teaching fellows program at Columbia and became a secondary school science teacher. Her first teaching job was in a conventional public school. Wendy, along with her former assistant principal and two other teachers, then became founding members of their EL School. Wendy typically engages in two large expeditions with her students during the year, one in the fall, and one in the spring. She says that about 60% of her curriculum is project based, and told us that the difference between project-based and expedition based learning is that in

projects, “no other teachers are involved.” Expeditions involve other teachers as an “integral part of it.”

The expedition that was a part of this research was grounded in the questions, “What sustains us?” and “Do we need a food revolution?” It followed on a social studies unit on the American Revolution and students simultaneously were working on point-of-view writing in an English class. In class, students read aloud from Michael Pollan’s *Omnivore’s Dilemma*, watched clips of Jamie Oliver’s *Food Nation*, grew vegetables in a lab garden, and made a trip to a local nature museum to grow herbs. They worked on products that included a point-of-view essay about a hamburger traveling through the digestive system and a healthy eating brochure that was handed out at a local farmer’s market. They also wrote an essay about whether or not we, as a society, need a food revolution using evidence from the texts they had read and viewed throughout the expedition. Students presented their final products to their parents, teachers, staff, and community members.

Lee. Lee has been teaching for the past six years. Lee graduated from college with a major in biochemistry and a minor computer science. He then received a Master of Science in bioengineering and is “all but dissertation” in a doctoral program in molecular biophysics. He began teaching math and science in the city in a progressive school, meaning that when he came to the EL School he was “used to interdisciplinary work, portfolios, and real-world connections.” After the school experienced a “phase out,” Lee’s next move was to leave the classroom and enter a Ph.D. program, but he realized it “wasn’t for him.” A year ago, he found himself looking to teach in a school that was “compatible with [his] philosophy,” of education, involving: “experiential education, adventure, and risk.” He applied to an EL school and discovered that it was a “good fit.” He has been teaching at this EL school for one-year.

Lee’s expedition was titled “Survival in the City” and engaged students in an interdisciplinary exploration that considered the guiding questions: “Who will survive?” “Why is water critical for life?” and “How do we determine the value of resources?” Specifically, this expedition targeted key standards that included concepts such as:

- The scientific method is essential to making rational and responsible decisions about protecting and preserving the planet.
- The ability to critically think about an issue and thoughtfully interpret information is necessary to guide individual and global decision-making.
- Water is a finite resource that is essential for basic human survival.
- Every environmental decision has a social, economic and political impact.

Students in this interdisciplinary expedition engaged in book clubs that included texts such as *Thirst: Fighting the Corporate Theft of Our Water* and *Parable of the*

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Sower, a dystopian book on water scarcity, local food production, politics, poverty and sustainability. They conducted fieldwork in which they partnered with local scientists to take water samples from local rivers, analyze data, create lab reports, and craft a culminating product: public service campaigns to raise awareness and promote potable water around the world. Additionally, a key product to emerge from the expedition was students' development of a grant to start a school-wide community garden initiative on the school grounds. As a result of students' efforts, the 2009-2010 school year saw the establishment of a targeted garden project manager position, staffed by a former EL teacher, Hannah. In this role, she carried the expedition forward by building connections with local organizations and supporting teachers in creating authentic connections from the garden to their classrooms. Hannah believes that the garden allows "access to multiple content areas," and "has an impact on the community," since "kids can change their environment."

Data Sources

Interviews. Interviews are a key source of data in qualitative case studies as they assist researchers in understanding the recounted experiences of the participants (Bogdan & Bilken, 1998; Lincoln & Guba, 1985). We conducted two one-hour semi-structured interviews with each participant and single interviews with additional staff members involved in professional development for a total of 10 interviews. Interviews were transcribed and uploaded onto Atlas ti, a program used for qualitative research data storage and analysis.

Site Visits. We conducted site visits of approximately 20 days of professional development and networking activities throughout the three months of data collection. In addition we spent two or more full school-days with each of our participants at a pre-defined time of their choosing. We compiled field-notes during all observations. These notes were then transferred to an electronic format and loaded onto Atlas ti.

Documents. We accessed documents from varied sources. We collected three years of monthly newsletters related to professional development, materials given to teachers during professional development sessions, curriculum materials written by teachers, student writing and project samples collected by teachers, teacher reflections from professional development sessions, professional development agendas and planning materials, and School Designer field-logs about coaching the two science teachers.

Data Analysis

We began data analysis by crafting initial codes while inputting data into Atlas ti. These codes reflected our nascent theorizing about the data and we created analytic memos to deepen our understandings of these codes. This early writing and analysis helped us begin identifying categories for the data. As we completed

data collection we revisited our data and solidified codes, defining each. Both researchers reviewed all data and codes. We triangulated our data in order to find “convergence[s] of information” (Creswell, 1998, p. 213). Lastly, as posited by the literature, we conducted member checks with our participants (Creswell, 1998; Lincoln & Guba, 1985). This allowed us not only to confirm our findings, but to provide us with an additional source of data.

Findings

In this section we highlight the key components of EL professional development that are particularly important in supporting teachers who engage in environmental education teaching. We then explore the ways in which the two teachers narrated their experiences of developing knowledge and skills targeting EE into their practices and what—if any—impact the PD had on their curriculum, pedagogy, and students’ experiences. We discovered four key aspects of EL professional development: immersion into real-world tasks, inquiry-based learning, ongoing support at school via coaching, and connection to a broader world through authentic action.

Real-World Tasks

Research on professional development in environmental education suggests the importance of teachers doing field research themselves (Barnett, Lord, Strauss, Rosca, Langford, Chavez, & Deni, 2006; Meichtry & Smith, 2007; Shepardson, Harbor, Cooper, & McDonald, 2002). As previously mentioned, the discomfort that many teachers have with field investigations is often a reflection of their own limited exposure to real world environmental educational experience. Shepardson, Harbor, Cooper, and McDonald (2002) write that, “The implication for teacher professional development is that it is critical to actively engage teachers in investigating the environment through designing and conducting their own environmental research projects, at the same time integrating environmental science content to explain their results” (p. 35).

All EL teachers entering into a school are required to attend two summer institutes, titled Secondary Schools Week I and II. Week I centers on immersing teachers in a condensed “slice” of a science or humanities learning expedition with embedded literacy practices, specifically reader and writer’s workshop models. Participants experience compelling content, engage in workshops to build background knowledge, conduct fieldwork, create products, present to authentic audiences, and debrief/reflect on the active pedagogy strategies modeled in the teaching of learning expeditions. Week II is designed to focus more deeply on other characteristics and structures of EL secondary schools related to assessment, grading and reporting, curriculum, and other pragmatic structures unique to the EL model.

Having attended Week I in 2009, Lee explained, “The slice in Baltimore was my first immersion in EL. We did what we expected our students to do in class. I

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felt like it was beneficial and compatible to my teaching and learning.” He added, “It was really meticulous and thoughtful. We started with a mystery piece to make everyone curious about the content. I remember experiencing fieldwork and expedition in truest sense - learning through service and creating an authentic product.” Lee’s slice of an expedition centered on watersheds, investigating questions such as, “What are the unique challenges facing urban watersheds?” and “What’s my impact on a watershed?” Teachers analyzed the impact of urbanization on Baltimore’s watersheds, visited local watersheds, conducted water-testing and analyses, learned about impervious surfaces, and created an educational outreach product to inform citizens about what they can do to help reach the goal of a swimmable, fishable, and trash-free harbor by 2020. Such tasks reflect Darling-Hammond and McLaughlin’s elements for effective professional development. Lee corroborates this through a reflection on his experience and how it transfers to his classroom practice:

[My EL slice of an expedition] was a true one. The ones we’ve done at school haven’t been as good as that. We have some of the components of the expedition, but never all of them—like the service. Our products aren’t as authentic—kids aren’t always doing something beneficial for society.

His observation—on the *lack of action* in his own classroom—recalls the CSCT model of teacher professional development, which encourages teachers to support student action based on analyzing the ethical implications of the environmental issues studied. This represents a gap between Lee’s PD experience and the experience he constructed for his students (whether due to time or planning challenges). However, the school’s broader work on a school garden initiative illustrates a way in which the school community tackled this challenge to rich results. Hannah, the garden project manager, expressed in an interview:

Everyone was working for a common goal; we included everyone—new students, English Language Learners, kids of all different abilities...it was a true spectrum! During the students’ presentations, they got to see other kids’ work, and they were blown away! They couldn’t believe how much they had produced: I mean, they were getting in the news, on TV, people were blogging about it, and students were thrilled! And, all of the products were authentic. Some of the students planted seeds, some silk-screened T-shirts, some created a mural that’s mounted in courtyard. It’s real EL practice—well thought out and implemented! Students also gained access to different content through the garden, and felt like they had an impact on the community.

Unlike Lee, Wendy was less impressed with her initial science slice (she later explained she was one of the earliest participants in a new slice, well before the professional development experience had been codified by the organization). However, she felt the professional development experience provided the “backbone of the project.” Similar to Lee and Hannah, Wendy also recognizes the need to create real-world connections for students in order to deepen their learning experience. She elucidates:

...transference is really important to me. In an expedition...I was never in this building...I was doing water-testing every day. But the kids—their comment was ‘I actually feel like a scientist, I feel like I’m doing something, I’m making something, I’m not just sitting in a room with someone talking at me, I made this, and now I’m sharing it with all of you.’ So...with this one...it’s that pamphlet—Look I made this and now I’m giving it to these people and they’re reading it and look my work did something—it left here and it’s in my community now. It’s not just in this building—someone else is taking it. And it’s that that I want them to get—the feeling that they can make something or build something that’s beyond these walls.

Both Lee and Wendy had experiences in professional development that underscored the importance of real world experiences. While Lee feels he is not always able to fully transfer that to his own classroom, he is able to reflect on the distance between what he has seen as possible and what he is currently able to achieve. The professional development experience gave both teachers a mental image that offers a framework for reflection and can therefore help to guide their practice. The CSCT model highlights the importance of reflection as a critical teacher skill; our interviews and observations of professional development activities suggest that EL professional development helped to build that skill both through those mental images and frameworks and through the debriefing sessions we discuss further on.

Inquiry-Based Learning

As explained in the National Science Education Standards (1996) professional development at its core is about “learning science, learning to teach science, and learning to learn” (http://www.nap.edu/openbook.php?record_id=4962&page=58). EL professes to promote teacher professional development that is “active and challenging” and supports teachers in engaging their students in “long term investigations of important questions” and compelling topics. In PD, as Lee recounts above, teachers themselves are hooked into content in various ways: a mystery piece to inspire inquiry, hands-on activities and texts to build knowledge, connections to fieldwork and experts to network ideas, and collaboration to craft outstanding products. As Darling-Hammond and McLaughlin tell us, quality professional development must be grounded in inquiry, particularly if, as the CSCT model suggests, teachers want to help students inquire about sustainability and the environment.

Lee acknowledges that creating curiosity is a key piece of engaging students, and a strategy he experienced in PD: “EL is compatible with my philosophy on inquiry, adventure, and risk—I think kids need to experiment. I’ve seen inquiry work with kids where they’re able to construct their own meaning. I like the way it works.” Engaging in a learning expedition highlights how inquiry emerges. Wendy elaborates:

...We looked at data and decided if this soil was good for plants. It’s about what they eat and how it’s grown. If what they eat affects their bodies and who they are, and the heavy metals in the soil are high, they thought, “No, no, no!” The

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learning experiences were given so they would get to this on their own. That's why inquiry takes a lot of time.

Wendy also frames her teaching through guiding questions, such as “Why do we need a food revolution?” which drives students’ explorations of content. When discussing Wendy’s growth as a teacher over her years working with EL and through the different forms of EL professional development, the school instructional guide, Ben, described Wendy’s “paradigm shift” in terms of “how teaching and learning look in science.” We knew from the CSCT model that this was significant; Wendy had made a shift *away* from being the “communicator of knowledge.” As Ben explains below, this shift allowed her to further encourage inquiry-based practice in her classroom that is at the core of EL pedagogy. Practice of this kind requires a belief in the power of student questions:

She’s seen how rich the experience is for the kids and how articulate the kids can be when they have those experiences. When she saw what the kids were doing she was able to change her thinking... You can let go of some control of the curriculum because its nature is inquiry for science. Kids will automatically ask those questions when you let them... It requires an incredible level of faith in kids... I have to believe that one kid is going to ask the right question. And then you start to think about your whole classroom differently. It’s shared control in some ways and it’s really this ton of faith in kids’ ability to drive their own understanding.

Understanding that inquiry is not *just* a pedagogical practice, but, in fact, a philosophical shift in terms of how teachers understand kids leads to differences in how they organize environmental science classrooms. There was some evidence of this in the student work from Wendy’s classroom. The classroom was dotted with concept maps about ideas related to *The Omnivores Dilemma* that included questions and explorations of concepts related to “corn” and “obesity.” Observation data emphasize a stronger focus on products than on inquiry although there was insufficient data to make clear which drove what—the products or the inquiry.

While it was clear to us that inquiry was an essential component of the EL professional development workshops and slices that helped teachers to see its centrality in environmental education, it is clear from Ben’s discussion of his work with Wendy that for it to be effectively implemented in practice ongoing support was necessary.

Ongoing Support

The content knowledge and instructional strategies needed to be an effective Science teacher are not static. Understanding the process of learning is also continually developing, requiring that teachers be involved in considering new approaches to teaching, assessment, and curriculum. Research indicates that professional development is potent when deepened through on-going coaching support and collaboration with colleagues (Ball & Cohen, 1999; Darling-Hammond & McLaughlin, 1995;

Hawley & Valli, 1999; Lieberman & Grolnick, 1996; Lieberman & McLaughlin, 1992; McLaughlin & Talbert, 2001; 2006; Warren Little, 1999; Wilson & Berne, 1999). EE teachers who have engaged in professional development require ongoing support in the “professional dimensions” described in the CSCT model in order to sustain effort in these practices, in particular given how different such practices may seem in the face of their colleagues (Barnett, Lord, Strauss, Rosca, Longrod, Chavez, & Deni, 2006; Meichtry & Smith, 2007).

Beyond national and regional institutes, EL also provides school-based professional development through a two-pronged approach. One prong is in the form of an instructional guide, an on-site coach with a focus on supporting teachers’ implementation of learning expeditions—and the curriculum planning and active pedagogy that accompanies them. The second layer is a school designer, generally on-site one-to-two days per week, who not only facilitates whole-staff professional development (designed jointly with the instructional guide and school leadership), but also coaches the instructional guide and teachers, bringing alignment to the school’s professional development plan, strategic plan, and other measures of accountability.

Both Wendy and Lee identified on-site support as critical in helping them transfer their professional development to classroom practice. For instance, Lee expressed, “The school designer and instructional guide facilitated the expedition planning conversation and then it gained traction with the development of our school garden. The garden became metaphor for the city and how to make sustainable.” Wendy concurred, noting that she worked with the instructional guide to construct the expedition and identify resources. In addition, she offered a key to on-the-ground planning supports, explaining:

Fridays we stay until 3 and...we meet as a faculty and we’re taught: first we got to watch an actual lesson being given by someone and then we broke it down for each of the steps, what’s required, why is it important, how do we use it, and then we got to take our lessons that we’ve [the 7th grade team] written and change them together as a group to make them fit into the gradual release of responsibility [I do, we do, you do] model.

Wendy asserted that this professional development influenced her practice, elaborating, “It motivated me to rewrite my lessons, to redo other things or figure out how to make it work better and...it made me much more efficient.” Her reflection echoes the theoretical models informing this research: that teacher effectiveness in environmental education relies upon reflection, ongoing support, and collaboration with a network of colleagues. She points to co-operative planning among grade-team members, which offers an opportunity to synthesize concepts and skills from many disciplines. Such is the permeability, or even the breaking down, of subject boundaries promoted by environmental education.

The work on inquiry described above, so critical to the kind of environmental education that fosters behavior change and action, requires ongoing support, par-

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ticularly for new EL teachers. Early on Ben worked closely with Wendy on designing and implementing expeditions while now, he told us his work is largely in the early stages of expedition development. For this particular expedition he helped “coach her through how to come up with a big enough question. Once I do that with her she runs with it. I think she’s getting closer to doing that by herself. I do tons of think alouds. What can we tap into “right now”? So I start with that.” This kind of coaching, coupled with an emphasis on environmental education focused on inquiry helps an EL teacher foster a community of inquiry in her classroom among her students.

Both pieces of our theoretical framework emphasize the importance of relationships, from coaching to networking and collaboration. Throughout the study and the development and implementation of these expeditions we observed how these relationships overlapped and worked together; collaboration with colleagues and networking with local community groups were particular to enacting expeditions, but the coaching relationship worked to support our participants both with the creation of the expeditions as well as the day-to-day teaching of them. This is aligned with Darling Hammond and McLaughlin’s research, which identifies coaching as an essential support for effective professional development, but our research findings also indicate how complex and layered that coaching needs to be to provide a coherent and thoughtful experience for teachers.

Connection to a Broader World through Authentic Action

Research suggests that teacher professional development in environmental education should involve participants “in the active investigation and amelioration of the real world problems of relevance to the communities in which they teach” (<http://unesdoc.unesco.org/images/0010/001056/105607c.pdf>). Teachers should then encourage students to be actively involved in solving real world problems as part of an environmental education curriculum. Learning how to do this is complex, and a portion of the EL slice is dedicated to experiencing the kind of activist oriented environmental work that the two teachers here have tried to construct for their students. For example, this summer, teachers studied the dynamics of the hydrologic cycle with an emphasis on the Chesapeake Bay Watershed and the Baltimore Harbor. The fieldwork involved data collection, observations, and water quality monitoring to investigate how humans impact their environment. Along with extensive text materials and the use of local experts the teachers created an educational outreach product to advocate for a swimmable, fishable, trash-free harbor by 2020.

Throughout the experience, teachers shifted between two roles: student and teacher. While immersed as students, they learned rich science content facilitated through active pedagogy strategies; while reflecting as teachers, they debriefed the experiences and considered how they might transfer to classroom practice or adapt to better fit their context. This shifting between student and teacher “hat” (see Klein & Riordan, in press) throughout professional development is key to helping teachers

build reflective capacity and more effectively construct intentional environmental curriculum.

Wendy felt the most important work her students did was when she linked students' learning in her 7th grade Science Expedition to the broader world. She described the learning that came out of students' brochures created to hand out at the farmer's market as well as their essays on the question "Do we need a food revolution?"

The most powerful [outcome] I thought were the connections that they made to themselves and then the realization of how unhealthy some of their diets are based on family time, when they eat, and who is home. They did a really good job of connecting it to people's schedules as opposed to money or anything - just where they lived, where they were located, and what was going on in people's lives and how they were forced to eat this kind of food because nobody was home to cook for them. This is what they were able to make on their own...

While Wendy's students were clearly able to do some important thinking around the ideas of food, nutrition, and sustainability, there were limitations in terms of the kind of action she felt she and her students could take within their expedition. At one point Wendy suggested that while it might be interesting for students to examine the food in the school's cafeteria,

...it didn't seem right to let them think that they had some chance in changing that when in fact we don't. There's nothing in my power that would enable them to make any real change or impact in the school lunches, at least not yet. We can look at them, we can talk about them—maybe it will help influence their food choices in the school lunch but I can't make a change in that right now.

What was unclear to us was why the project could not move in that direction. It seemed a genuine opportunity given the "revolutionary" nature of the inquiry, but there seemed no space for initiating action. And, in fact, perhaps wary of opening a can of worms beyond her control, Wendy never looked at or talked about school lunches with her students.

Lee indicated that he observed a shift in his students' engagement when they began to interact with the broader community. In his expedition Lee first created a "need to know" by posing the question, "Why can I drink the water that falls from the sky but can't drink the water in the local river?" Students then learned content similar to that which Lee himself experienced in the EL Schools Institute. They collected data with experts, investigated polluted water in the local area, made connections between human actions and impact on ecosystems, considered how individual choices and societal actions can contribute to improving the environment, and explored scientific innovations for making potable water accessible world-wide.

Lee shared:

Towards the middle and end of the Expedition, when I was taking kids to places I saw them asking question to actual people—farmers. They asked about the quality of food, where it was grown, and then the farmers responded back with technical

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details. The kids are now willing to ask good questions and are able to connect to different classes and the community. I think that was important to me—the content was important, but more important were the connections in classes and world around them. For kids, it's hard to see connections in things abstract—studying the environment allows them to see it for real.

There are a number of significant aspects to these interactions: Lee exhibits the “faith” in kids that Ben describes—that they will ask real questions when faced in authentic contexts with people who have information to give them. In the action of creating authentic experiences that connect students to a broader audience, he promoted accountability and students responded. Lee's expedition asked the students to see themselves as active citizens in their communities and in the larger world—a true interconnected system. In the creation and enactment of the final products we see the heart of the CSCT model in action—the connection of the competencies in five domains: knowledge (about the hydrologic cycle of climate and water, toxicity, and advocacy, action (planting the garden and partnering with local organizations, values (about the values of sustainability), emotions (related to health and sustainability), and systems thinking (through understanding how pieces are influenced within the whole—such as ecosystems or human actions) situated within the overall teacher competencies: teaching (on a daily basis but in a way that was less about teacher as “communicator of knowledge” and more as teacher engaged in dynamic collaboration with students), reflecting/visioning (both before with EL support staff and other teachers/staff within the building and throughout the expedition), and networking (with other teachers within the school, support staff within EL, and local organizations)—all competencies Lee had to draw on to do this work effectively.

It became clear the culmination of the expedition—presentations to outside audiences and later development of the school garden—was essential in impacting student work and helping them to connect to a broader community. What seemed to motivate students to inquire and connect content throughout multiple subject areas was when meaningful action built within the project required this.

Implications

Our research yields a number of implications on various policy levels for professional development in environmental education. At its heart, professional development in environmental education should inspire curiosity, be participatory, and practice-based. It should encourage the active investigation of real problems, rather than abstract, with an emphasis on problem solving and decision-making—and support teachers in transferring those pedagogical practices to their interactions with students. Both teachers in this study were successful to varying degrees in “encouraging behavior and changing action” in their students. The work of Wendy's students demonstrates a remarkable awareness about the impact of the fast food

diet on urban youth. Yet it was clear there was room for increased action. Lee's students launched substantial action in their school by first exhibiting their work at the local city hall and inviting community members to learn about human impact on the environment, and then by sparking the development of the school's garden. Long-term student behavioral change was not within the scope of this study and should be further explored.

Broadly, on a reform level, EE has much to teach professional developers about engaging teachers and creating active citizens. As indicated from Lee and Wendy's experiences, through promoting authentic and relevant teacher experiences, teachers are more likely to engage students, help them realize connections and patterns, raise questions, and act on the values of sustainability, such as: Who made this decision and who benefits from it? Have the long-term repercussions been considered?

If we want to continue to support teachers in undertaking rich inquiry-based experiences, we cannot rely solely on professional development programs which may fund only one or two teachers in a single departments or school. Lack of support among colleagues may make *sustained* implementation challenging. One advantage of a model like EL is that the nature of an expedition-based school model provides the structures that are most conducive to environmental education. Teachers cite the "time and energy" needed to implement the kind of environmental education required herein as a barrier to implementing EE (Ernst, 2009). However, EL teachers are expected to implement expeditions, and EL promotes school structures such as common planning and block scheduling to allow teachers adequate time and support to implement them well. Effective environmental education benefits us all; to live in a world is to impact it—both positively and negatively. To sustain our world, we need larger scale school reform that builds values into the school system.

Lastly, students' responses to environmental issues through action remain a key area for study. The energy incited by these projects was evident in their work, their willingness to talk with researchers informally about their learning, and in the actions they undertook to spark transformation. In our shrinking world, sustaining the environment relies on students becoming problem-solvers, critical-thinkers, and ultimately, change-makers.

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