

**Attempting to Make Place-Based Pedagogy on Environmental Sustainability Integral to Teaching and Learning in Middle School: An Instrumental Case Study**

Gayle Anne Buck  
Indiana University, United States

Kristin Cook  
Bellarmine University, United States

Ingrid Weiland Carter  
Metropolitan State University of Denver, United States

**Abstract**

Local environmental topics can serve to motivate and empower students to change their behavior and take action for sustainable practices. In order to better support middle level teachers as they incorporate such topics into their professional practice, we sought to enhance our own understanding of their classroom-based experiences. In light of this, we conducted this study on a middle level teacher as she attempted to integrate place-based pedagogy on environmental sustainability into her science curriculum. The guiding questions of the study were: a) What student experiences emerged as a result of the teacher's implementation of the curriculum?, and b) What beliefs, understandings and practices emerged for the teacher as a result of the experiences? Data sources included interviews, observations and written documents. The findings revealed that the teacher's efforts to connect the instruction to a local issue of water quality led to student engagement and an eagerness on the part of the students to share what they did with others. Unfortunately, several aspects of the teacher's efforts did not successfully lead to greater student understanding of content and multiple viewpoints on local issues. The results extend current understandings of how to support middle level teachers in the development, enactment, and refinement of place-based pedagogy on environmental sustainability.

**Key Words:** Place-Based Pedagogy; Sustainability; Middle Level Science

**Please address all correspondence to:** Gayle Buck, 201 North Rose Avenue, Bloomington, IN 47405, [gabuck@indiana.edu](mailto:gabuck@indiana.edu)

**Introduction**

Although people define environmental sustainability in many different ways, most definitions involve addressing the ecological and sociological needs of the present without compromising our ability to address the needs of future generations (World Commission on Environment and Development, 1987). Incorporating topics related to environmental sustainability into teaching and learning can serve to motivate and empower learners to change their behavior and take action for environmentally sustainable practices (United Nations Educational, Scientific and Cultural Organizations, 2013). By contextualizing these topics in

local issues, learning becomes meaningful for the students and the local community. Place-based pedagogy as an instructional approach underscores the aim of centralizing students' learning within their community. This pedagogy is based on the premise that education sometimes focuses too much on issues removed from the students' daily lives resulting in the students losing their connection to a place (Sobel, 2005). In place-based pedagogy on environmental sustainability, teachers situate environmental issues within the students' local area and establish a strong educational grounding; then, as students mature, global environmental concerns may be better addressed. The community surrounding the school becomes another text that students are taught to read, synthesize, explore, and elaborate upon. Studies in this area demonstrate the potential for a profound bio-ecological connection between physical location and student cognition (Bryant, Schonemann, & Karpa, 2010). Such a pedagogical approach, however, differs greatly from traditional approaches to teaching and learning that many teachers have experienced. For example, this approach is contextualized in the local community, fosters an appreciation of place and emphasizes students as knowledge producers. It is not simply a matter of teachers teaching new material; this holistic approach instead impacts, and is impacted by, the students, classroom, teachers, school, and community.

In our work with teachers in the United States, we seek to enhance the teaching and learning about environmental sustainability by emphasizing the use of place-based pedagogy. Teachers must hold beliefs that are consistent with reform-based practices (Crawford, 2007). To that end, in our professional development work, we foster positive beliefs and accurate understandings about this pedagogical approach, as well as guide and support teachers in the development of place-based sustainability curricular units for their classrooms. We understand, however, that teachers' beliefs about best practice and actual classroom practice may contrast starkly (Crawford, 2007; Simmons, et al., 1999). Thus, in order to better assure the enactment and refinement of these units, we wanted to enhance our own understanding of the interactive process of changing beliefs, understandings and practice. We conducted this study on a middle-level teacher as she attempted to implement her place-based unit on environmental sustainability.

The purpose of this instrumental case study was to understand the middle level classroom experiences associated with implementing place-based pedagogy on environmental sustainability for the first time. This research was guided by two questions: (1) What student experiences emerged as a result of the curriculum?, and (2) What beliefs, understandings and practices emerged for the teacher as a result of the experiences? In this manuscript, "curriculum" is being defined as actual opportunities, experiences, and learning (Posner, 1995). This definition allows us to extend our view beyond a planned unit-of-study (referred to as "unit" in this manuscript).

## Literature

Sobel (2005) noted that education on environmental topics has its roots in the "Nature Studies" movement of the early twentieth century. The educational efforts inherent in this movement were typically focused on ecology, and many focused on the local environment. Following this time, the focus became global, abstract environmental concepts, and catastrophe education (e.g., rainforest destruction, ozone depletion, toxic waste). Place-based pedagogy takes us back to the roots of environmental education, focusing on the local while maintaining a more inclusive, holistic focus. Place-based pedagogy focuses on the built environment alongside the

natural, with the objective to look at how they interact with and shape each other. Instead of emphasizing issues that are not directly connected to the daily lives and actions of students, place-based pedagogy emphasizes learning and experiences in the immediate schoolyard neighborhood, town, or community of the students (van Eijck, 2010).

Common principles of place-based pedagogy include (a) taking advantage of local possibilities for curriculum development, (b) students as knowledge producers, (c) learning from community members as well as teachers, and (d) fostering a regard and appreciation for home community (Smith & Sobel, 2010). Place is more than an address or a plot of land, it involves the history, emotions, stories, culture, aesthetics, and social problems of the place (Sobel, 2005). The place-based pedagogy movement emerged as an attempt to link ecological and human aspects of place; with an underlying purpose of learning to act responsibly in regards to the environment.

Originally, the movement emphasized a place-as-land approach with the focus on taking care of the local land (Karrow & Fazio, 2010). As time went on, however, place-based pedagogy evolved into a type of critical instruction with an emphasis on the underlying social, cultural, economic, and political issues that affect place. The inclusion of human culture brought with it discussions of conflicts inherent in dominant American culture (Gruenewald, 2003). As a result, complications have surfaced as it quickly became more socially and politically charged (Karrow & Fazio, 2010). In addition, the pedagogical approach necessary for this emerging understanding of place was different from anything teachers had experienced in their preparation programs. Place-based advocates seek an intra- and integrated curriculum, project-based learning, collaborative teaching and learning, and the extensive use of community resources (Sobel, 2005). The new curriculum is necessarily interdisciplinary, even including many subjects not traditionally a part of a school's curriculum. All these aspects of instruction differ from the common approach to science teaching and learning.

Although the value of place-based pedagogy has been recognized by many reform-based documents, it is not yet common in classrooms. This is due, in part, to the fact that most teachers have not experienced teaching or learning through place-based approaches (Meichtry & Smith, 2007). Several studies have examined efforts designed to offer such experiences. Powers (2004) completed a cross-case study on four such programs. Her study utilized interviews and field observations to determine the effects of these programs on teachers, students, schools, and communities. Her results showed that teachers increased their use of local places and resources, use of interdisciplinary teaching, collaborations with other colleagues, leadership capacity, and curriculum planning skills. She provides five categories of recommendations for professional development programs. These include: (a) effective start-up approaches; (b) teachers, administrators, and community buy-in; (c) partnerships and collaborations; (d) communication; and (e) other recommendations.

Glasson, Frykholm, Mhango, and Phiri (2006) completed a study on Malawian primary teacher educators taking part in a professional development program. They studied these teacher educators' perspectives and dispositions toward teaching about ecological sustainability issues in Malawi as they participated in a 3-week, 6-hours-per-day methods course that included teaching place-based ecological sustainability issues to primary children. This work included topics of

ecological sustainability, culture, and place-based pedagogy. The researchers analyzed course documents and observed classroom interactions. They found that although the teachers embraced the inquiry-oriented pedagogies and connections to indigenous science as a means to involve the children in investigations, decision-making, and ownership of environmental issues; there were challenges connected to the availability of resources. In addition, Meichtry and Smith (2007) studied the impact of a professional development program on 20 K-12 teachers' confidence, practices and attitudes after they participated in a 6-day place-based immersion experience focused on a Kentucky watershed. They analyzed the data from a Likert-type scale survey administered on a pre-intervention, post-intervention, and long-term (9-months) basis. They found that the teachers' believed the professional development had a strong impact on their confidence in utilizing community resources in their lessons, conducting field investigations, and the ability to connect watershed topics to society.

Chinn (2006) also studied her own efforts in regards to preparing teachers to utilize place-based pedagogies. Her 10-day program included the use of cultural translators who spoke Hawaiian and explained Hawaiian culture. They also facilitated conversations on how the culture related to teaching and learning. She analyzed participant observations, photographic records, e-mails, lesson plans, evaluations, participant journals, photographs, and field notes to assess the impact of cultural immersion and situated learning on non-Native Hawaiian teachers' cultural knowledge and efforts in addressing content standards in the context of the place and culture of Native Hawaiian ancestry. Chinn found that the teachers came to understand the importance of developing a sense of place. This understanding led to an increase in place-based pedagogy in their classrooms. She later studied the impact of another professional development program in regards to 19 secondary teachers' views of and desire to develop place-based curricula on environmental issues (Chinn, 2007). She analyzed teacher responses to writing prompts, emails, and program evaluations. Her findings show that the teachers evaluated indigenous practices more positively, critiqued the absence of locally relevant science and indigenous knowledge in their curricula, and developed curricula addressing local issues, culture, and place.

The literature noted above became the most influential to our efforts in supporting teachers attempting to make place-based pedagogy on environmental sustainability integral to teaching and learning. We utilized Smith and Sobel's (2010) definition of place-based pedagogy in a manner that embraced the social and political influences noted by Karrow and Fazio (2010). We understood the potential impacts of such efforts as noted by the previous studies, but sought to further understand the barriers or supports that foster such outcomes. In light of this, our study sought to gain a greater depth of insight into the experience of being a teacher attempting to make place-based pedagogy on environmental sustainability integral to her students learning experience.

### **Methodology**

We conducted an instrumental case study (Creswell, 2012) to best understand the experiences of a middle level teacher's first attempts at integrating place-based pedagogy on environmental sustainability into her science curriculum. A case study is defined as an exploration of a bounded system over time through detailed, in-depth data collection involving multiple sources of information (Creswell, 2012; Stake, 1995; Yin, 2008). Case studies are

particularly appropriate for understanding the details and complexity of a situation (Stake, 1995), and an instrumental case study provides insights into a topic. We sought to understand curricula (actual opportunities, experiences, and learning) that occur in a complex environment, such as an urban classroom. Thus, an instrumental case study was selected as a methodological approach that allowed for a detailed, in-depth exploration of the topic of place-based pedagogy on environmental sustainability in a manner that would allow for insights into what the teacher and students go through when experiencing this unique pedagogical experience. Due to the complexity inherent in having an active process involving a teacher, students, curricula, content, and community, we selected a single case approach. The single case examined with this study was designed to illuminate an urban middle school science teacher's classroom experience. This instrumental case focused on one teacher (a teacher that had developed a place-based unit on environmental sustainability), bounded by a set time (duration of the place-based unit) and by context (a middle school in a large urban district).

### **Participants**

The primary participant in this study, Mrs. Pyle, was recruited from a cohort of teachers who previously took part in a professional development program on designing place-based curricula. She was selected due to the researchers' positive assessment of her theoretical understanding of place-based pedagogy on environmental sustainability and place-based unit, as well as her willingness to become involved in the study. As a result, she entered this case study with an understanding of place-based pedagogy instruction on environmental sustainability. In addition, she had also successfully designed a unit focused on a local environmental issue for her classroom. Assuring that the participant we selected had an adequate understanding of place-based pedagogy on environmental sustainability was critical to this study as it further validated that we were indeed investigating the classroom implementation (i.e., practice) and not a teacher's theoretical understanding.

Mrs. Pyle is an African American female, and at the time of this study, had taught at the middle school for 20+ years (the school population included 542 students, 96% Black, 41% of whom qualify for free lunch program). Prior to her career as an educator, Mrs. Pyle worked in the local steel mill industry. Her long-term connections to the community and industry were evident in her knowledge of local issues. The secondary participants in this study, Mrs. Pyle's urban eighth grade students who were all multi-generational African-Americans, were 24 students in one section of Mrs. Pyle's general science. The name of the teacher and the names of all student participants and school/community sites were changed to maintain confidentiality.

### **Unit**

Given her students' interest in and experience with the nearby lake and her own experience working in the steel mill industry, Mrs. Pyle centered her unit on a popular swimming spot in the students' hometown that was suspected of being heavily polluted by local steel mills, as well as by the surrounding business and residential community. She wanted her students to conduct scientific analysis of the water using probe-ware technology to determine if it were safe for swimming (see Table 1). During implementation, students were asked to contact local steel mills, local environmental protection agencies, and talk to people of the community about the health of the lake water. They took a field trip to the lake to collect water samples and investigate the surrounding area, and they conducted water tests back in the classroom (e.g., pH, turbidity,

dissolved oxygen, E. Coli). After researching acceptable ranges for their collected data, students were then asked to present their results to the rest of the class and make recommendations for enhancing the health of the lake.

*Table 1: Initial Worksheet Given to Students to Introduce Place-Based Investigation*

Is it "Steel" Hot?																			
Your parents are planning a family reunion to be held at Park Beach and Pavilion next year during the month of July. Your uncle works at [steel mill] and told your parents that his department pours superheated water into the lake near the spot where your picnic will be held. You have family members of all ages who hope to go swimming. Your family wants to know how the quality of the water will affect their plans. You volunteer to research and test the quality of the water, because you will study scientific inquiry, the earth's resources and the interdependence of life as part of your coursework this school year. Your parents agree that it would be worth investigating and are planning a family reunion meeting within the next several weeks. You decide to develop a power point presentation to describe your findings for the upcoming meeting. Your results will help determine whether or not Park Beach will be used.																			
Task	Over the next six weeks, you will complete research on [Lake] at Park Beach by selecting and conducting physical, chemical and biological tests to be evaluated and recorded in your science journal. Use your data and results to develop a power point presentation or flyer to show at the family reunion meeting. Your family is counting on you to help determine if the [beach] site should be used or if they should choose another location.																		
Preliminary Work	During the first marking period, your class will study up to six topics that will assist you in completing your assignment. In your science journals, check off all lessons, activities, experiments, and research you conducted towards the completion of your task. Demonstrate knowledge of the scientific method using graphs, data tables, pictures etc. in your presentation. Cite all resources. The final activity will be a group (no more than 4 students) power point presentation or a flyer that will be used to determine if your family reunion could be safely held at Park Beach. There is one or more lessons/activities that will better prepare you to accomplish your task. Please check each of the lessons you completed as your class progresses towards your final assignment.																		
	<table border="1"> <thead> <tr> <th>Topic</th> <th>Activity</th> </tr> </thead> <tbody> <tr> <td rowspan="3">The Nature of Science: Formulating Conclusions/STANDARD 1</td> <td>IA Scientific Inquiry</td> </tr> <tr> <td>IIA Measurement/Graphing</td> </tr> <tr> <td>IIIA Technology and Society</td> </tr> <tr> <td rowspan="4">Properties of Matter and Earth's Resources/STANDARD 3A</td> <td>IA Water Chemistry</td> </tr> <tr> <td>IIA Water Temperature</td> </tr> <tr> <td>IIIA Density of a Liquid</td> </tr> <tr> <td>IVA Turbidity</td> </tr> <tr> <td rowspan="3">Changes in Matter/STANDARD 3B</td> <td>IA Water Quality</td> </tr> <tr> <td>IIA Dissolved Oxygen</td> </tr> <tr> <td>IIIA Acids, Bases, pH</td> </tr> <tr> <td rowspan="2">Changes in Living Systems/STANDARD 5</td> <td>IA Microbes</td> </tr> <tr> <td>IIA Cell Processes and Energy</td> </tr> </tbody> </table>	Topic	Activity	The Nature of Science: Formulating Conclusions/STANDARD 1	IA Scientific Inquiry	IIA Measurement/Graphing	IIIA Technology and Society	Properties of Matter and Earth's Resources/STANDARD 3A	IA Water Chemistry	IIA Water Temperature	IIIA Density of a Liquid	IVA Turbidity	Changes in Matter/STANDARD 3B	IA Water Quality	IIA Dissolved Oxygen	IIIA Acids, Bases, pH	Changes in Living Systems/STANDARD 5	IA Microbes	IIA Cell Processes and Energy
Topic	Activity																		
The Nature of Science: Formulating Conclusions/STANDARD 1	IA Scientific Inquiry																		
	IIA Measurement/Graphing																		
	IIIA Technology and Society																		
Properties of Matter and Earth's Resources/STANDARD 3A	IA Water Chemistry																		
	IIA Water Temperature																		
	IIIA Density of a Liquid																		
	IVA Turbidity																		
Changes in Matter/STANDARD 3B	IA Water Quality																		
	IIA Dissolved Oxygen																		
	IIIA Acids, Bases, pH																		
Changes in Living Systems/STANDARD 5	IA Microbes																		
	IIA Cell Processes and Energy																		

### Data Collection

Data sources for this study included (a) pre and post teacher interviews and survey reflections on classroom experiences, (b) post group interviews with student participants; (c) audiotapes and videotapes of the classroom, and (d) written plans including classroom artifacts from classroom implementation. Mrs. Pyle's experiences that resulted from the curriculum implementation were identified by her lesson plans and classroom observations, as well as debriefing sessions with researchers. Classroom documents served as secondary data sources.

Three video cameras were set up to capture classroom interactions. The first camera was focused on the teacher-student interactions, the second was moved around to focus on various

student groups, and the third was focused on one specific group of three students that was followed throughout the study. In addition, one video camera, held and controlled by one of the researchers, was used to capture student presentations at the completion of the study and the fieldwork during the field trip to the lake site. Mrs. Pyle and her students were videotaped on eight separate occasions during a two-month period.

Mrs. Pyle was interviewed pre and post study. These interviews, each lasting approximately 25 minutes, focused on her perceptions of the curriculum and learning approach. The interview questions were completed in a semi-structured format. Sample questions included: (a) Did the unit go as well as you had anticipated? (b) Did the student outcomes meet your expectations?, (c) Would you consider doing this project again? If so, how would you change it? Or, why would you choose not to change it?, and (d) Will you use this teaching approach again? Focus-group student interviews were conducted at the end of the study. Students were interviewed in groups of three for approximately 15-20 minutes. Sample questions included: (a) What did you like or not like about learning that was based in your community?, (b) Can you tell me about something you learned in this project that was interesting?, and (c) Did you do anything or talk about anything related to this project outside of class?

### **Data Analysis**

The data analysis procedure for this study was an inductive process that consisted of a thorough review of all sources, dividing them into text segments (e.g., naïve content understanding, accurate content understanding, familiarity of place, lack of familiarity of place, understandings of place). Once complete, the codes were examined for overlap and redundancy and collapsed into broad themes (e.g., connection to place, content connections) (Creswell, 2012). We used Nvivo software for coding—highlighting in the body of the texts that related to codes and doing multiple analyses of the data as we grouped them into the emerging themes. Themes that emerged were triangulated within and across data sources, with careful attention to maintaining an audit trail back to the original data.

### **Validation of Findings**

Construct validity was strengthened through the triangulation of perspectives and data sources. Triangulation of perspectives was conducted as these individuals came together to identify themes and analyze the data. Peer debriefings, during which the authors critiqued the method and checked the interpretation emerging from the data, were conducted throughout the study. Triangulation of data sources was accomplished through the use of interviews, observations, and written documents. Involving the participants in a manner that gave them a voice in the process strengthened face validity. All participants were fully informed of the intent of the study and the semi-structured nature of the interviews allowed them to represent their own experiences. Finally, our study had catalytic validity as the process was designed to inform persons seeking to improve teacher education in a manner that would lead to the successful implementation of place-based pedagogy on environmental sustainability.

### **Limitations**

Case study has its limitations for advancing grand generalizations (Stake, 1995). The purpose of this study was to present this particular case, not to generalize beyond the setting. Beyond the limitation of the methodological design, the teacher participant self-selected to take part in the study, thus, is not representative of all teachers. Mrs. Pyle demonstrated a high level of understanding and skill in designing such curricula. Having her as our primary participant allowed us to explore the impacts of the classroom and not lack of teacher understanding. Furthermore, because this study was within a relatively homogeneous school population (i.e., urban, African-American, low SES), it lacks a more holistic view of student experiences. We feel this is a strength of the study design, however, as it allowed us to explore the impacts of the curricula in large urban districts with high percentages of students from an underrepresented population.

### Findings

The purpose of this instrumental case study was to understand one teacher's experiences with implementing place-based pedagogy on environmental sustainability. This research was guided by two questions: (1) What student experiences emerged as a result of the teacher's implementation of the curriculum?, and (2) What beliefs, understandings and practices emerged for the teacher as a result of the experiences? The findings are presented here to demonstrate the understandings from the entire study, using specific quotes or written documents from individuals as supporting evidence.

#### **Research Question #1: What student experiences emerged as a result of the teacher's curriculum?**

The analysis of the verbatim interview transcripts from teacher and student interviews, classroom observations and planning documents revealed three categories of findings: a) learning to educate others, b) sociopolitical obstacles and multiple stakeholders, c) engagement for future inquiries, but lack of content connection, and d) connection to place.

**Learning to educate others.** We determined one of the major strengths of Mrs. Pyle's curriculum was the increased engagement of the students in a science lesson; one that would allow them to educate others about the science in their community. During one interview, Mrs. Pyle noted the importance of this when asked what she liked about the project:

So [the students] have had a chance to see how American life works not just political but as well as social. They felt like they were accomplishing something. And they were able to tell someone. I think they are in a position to help someone else as a result of this project.

Students echoed this sentiment during their interviews when they described how they would encourage others to think about the quality of the water before jumping in to swim. Angelique talked about educating others about potential pollution in the area:

People see it's the beach- of course it's going to be fun. As soon as you think beach, you think about getting into the water. But they really don't know about the water, with the pollution and stuff. Like the air we breathe, could hurt our lungs, or anything inside our bodies, it could hurt. The pollution in the water, in the air, or stuff in the food that we eat, it could hurt us. Make us die early.



Almost every student interviewed talked about how they would tell, or had already educated others, about the data they had collected at the beach. They seemed to take ownership of the project and desired to, as Deja said, “spread the word” about potential health risks associated with swimming in the water. Some students even reported talking about the project with their families,

I talked to my mom, and she knows this person that works in the steel mill. He said that they do dump some stuff into the lake and it does affect the community and it was really surprising to me because I didn't know that.

Students were eager to talk with others outside of class about their lake project. Students were concerned to learn that there were hidden issues that affected their health within their own community. This interest in and enthusiasm for the project was seen in their reported discussions about their findings with family members and friends.

**Sociopolitical obstacles and multiple stakeholders.** Our classroom observations revealed that one of the obstacles the teacher faced in implementing the unit was getting community members to respond to requests for information. The students had contacted the local steel mills with written requests for data that would help them determine the outflow of the factories that may have been contaminating the lake; however, despite their many attempts, they received no response from the companies. As well, students even had difficulty getting answers from the environmental agencies charged with protecting the lake. As it turned out, during the unit, one of the local environmental agencies had been recently closed. Mrs. Pyle commented on these observations during her interview. She noted that with the recent closing and the lack of ability to connect her students with those in the community who could help shed light on what was going on with the lake:

That just happened about a couple of weeks ago and the- the governor sanctioned all of this. So, our legislatures are really, really upset and they want some answers about why they shut down the agency. And that was the agency we were going to- we never could get in touch with them about the water quality.

Despite the lack of response from community stakeholders, our observations revealed that the students began to realize the complexity and divergent interests of people with regard to environmental issues such as water quality. We observed that when Mrs. Pyle asked the students about their findings with regard to the quality, or lack thereof, of the lake water, they responded with uncertainty about what could be done to improve the conditions of the lake. After a group of students attributed the pollution in the lake water with the local steel mill during their final classroom presentation, we asked them what they felt should be done about it during a focus-group interview:

Researcher: If the steel mill is one of those contributors to pollution, maybe in the air, maybe in the lake, do you feel like there is anything you can do about that?

Shawnee: Not really. I mean the steel mill is one of the biggest companies; it probably is the biggest company in our town, that's where most of our families work. So it's nothing we can really do about it, 'cause that'll stop most people's income.

Students seemed to acknowledge the complexity of environmental pollution and the multiple stakeholders that could be affected by it. They told us that they had family members who worked at the steel mills and realized that many community members' income was hinged

on the successful operation of the factories. They also acknowledged the many reasons that may have contributed to the lack of response from stakeholders. When we revisited and reflected on the written unit, we realized that the overall goal was to simply collect and analyze data to make recommendations to the rest of the class about swimming in the lake, and that students were not expected to discuss or make recommendations to community members or the business sector. Educating others (outside of their classroom) about the conditions or their concerns of the lake was not part of the classroom project, so students stopped short of thinking through plausible solutions to the environmental pollution and instead were left with a debilitating sense of the enormity of the issue.

**Engagement for future inquiries, but lack of content connection.** Our observations revealed that the students were highly engaged with the inquiry throughout the curriculum. They excitedly discussed who might be the potential polluters of the lake, they enthusiastically researched water quality reports online—even asking for passes to go to the library to do more research on their projects during their study halls; and they eagerly participated in data collection out at the lake despite the frigid winter temperatures. During an interview, Davon noted that he enjoyed the curriculum,

I think it's important because a lot of people don't get interested in school like that. So like if you make it fun, you make something that's like really an issue, they'll want to do it more. They'll like pay more attention because it is really something they can affect them.

Their engagement in the place-based curriculum on environmental sustainability stimulated students to ask questions for future inquiries. For example, during one class session Breon said, “I learned that the water is not good. I mean 'cause if it's in the water that's in the beach that we go to, is it in our tap water at home?” Also, Chris asked if they could do follow up tests on the air quality, wondering if there might be a connection between the water and the air pollution. This could have provided a great segue for future science instruction. Indeed, throughout the interview process, students unanimously wanted the project to extend to do something to clean up the lake. Aneisha claimed,

Well, we could all help out on cleaning up the beach. I did clean up the beach, sometimes, me and my cousins. We went to the beach sometimes, we cleaned up stuff. Well, in the lagoon people throw a lot of debris in there like you could see washing machines, trash, in the lagoon, and that goes right back to the lakes. So if the lagoon's, you know, trashed, then the lake might be trashed also.

While the instruction seemed to inspire an engagement for future inquiries, there was a lack of connection to the content of the curriculum. When interviewed, Xena and Keisha attempted to explain their data to the researcher:

Researcher: What are those things about like nitrates and phosphates, what is that? Where are they coming from? Or are they good or bad?

Xena: I wasn't listening when they were explaining it, it's all oxygen. So I really don't know where all these [data] are coming from. There are rumors about steel mill dumping all that in there, but I really don't know.

Keisha: I learned not to swim in the beach water, just like stay clear of it because I don't want to be sick, from all the E. coli, and dissolved oxygen. I'll take my chances in the sand.

As indicated here, our findings revealed that students did not understand what the tests for water quality meant. Though they collected the data and accurately reported their results during the final presentations, our observations showed that they did not seem to comprehend what the data meant about the lake. Both Xena and Keisha referenced oxygen (students had conducted tests on dissolved oxygen) as if it were a negative thing in and of itself. They did not understand what high or low values for dissolved oxygen meant in terms of health of the water, nor were they able to use the evidence they collected to propose recommendations for the lake.

**Connection to place.** Another strength of the instruction rested in its connection to place. Our observations revealed that the students were consistently drawing upon their personal experiences and relating them to the science with which they were engaging in class. For example, Ame reported when talking about changes they've noted in the lake, "I've seen a lot of dead fishes. It's been a lot of dead fishes. We used to go walking each day in the summer and seaweed is pushing them up I'm sure." Additionally, during an interview, Jamal shared that he asked his family about the lake and changes they had noted over time:

Many times my dad and I go fishing and when we go fishing we see that our blue gill most of the time has mercury in it, you can tell it, because it has yellow spots on the belly. And he said before when you went fishing as a child, it didn't happen, it was just natural, it was blue. But nowadays it has mercury in it so we don't even eat it we just throw it back in. So, the fishes aren't even clean so you know that the water quality cannot be good for us either.

The connection to place not only allowed students to bring in their personal experiences to the classroom, but also helped them see that understanding science can help the community. In effect, this inspired students to value the science they were learning and apply it to life outside of class. For example, students reported that the instruction was interesting because "We learned what's really in our town. What's really happening," and "We can help our lake so we can swim in it." Breon said, "I like the fact that [Mrs. Pyle] actually took the time out to show concern for our town." This connection to place inspired students to engage with the place-based inquiry and provided personal meaning to their science learning.

### **Research Question #2: What beliefs, understandings and practices emerged for the teacher as a result of the experiences?**

By analyzing interviews with Mrs. Pyle, the written unit and classroom observations, we were able to assess the degree to which her beliefs, understandings and practices with regard to this type of curricula changed as a result of this experience. Prior to the study, Mrs. Pyle reported that she did not formally integrate place-based learning into her instruction. By the end of the study, she reported that she incorporated her newly developed pedagogical understanding and skills related to place-based learning, which was evidenced by her developing and executing the unit on local water quality— an issue she believed was important due to its relevancy to students who swam in the lake and recent news about potential pollutants at the lakeshore:

It was very important- my students related to it immediately. Everyone has had an opportunity to go to [the shore]- they have been to the beach. They've never considered,

'I wonder if the water is clean,' never thought about that. And it has to be something that grabs their attention- it has to be something that is relevant- all teaching should be that way, it has to be relevant. It's not always like that, but for this unique type of project making it community based, uh, is most important because all of my students. They have always been interested in the project. They have always been interested- because it meant something to them. And they felt like they were really contributing.

Mrs. Pyle was excited by the fact that the students were relating science learning to their immediate place, and she encouraged them to question the pollution that was affecting their lake. She described the experience as leading to empowerment for the students in terms of asking questions for which answers are not easy to come by and can often be quite politically and economically influenced:

Which I wanted to say, I am really pleased with it [experience]. It'll be on going- because what they are looking at is Lead River and that is what we really need to look at because that is where the steel mill dumps all of their waste specifically. They do have a discharge that goes into the lake and that water is supposed to be clean. Okay that is what the guy told us from the steel mill—'No problems here,' but we don't believe him.

With regard to changes to her beliefs, Mrs. Pyle reported that she realized she needed to "pick out what [students] needed to learn in order to solve a problem," and "how to pull together an activity." Originally, she focused on one specific content standard in her teaching of science, but showcased that she came to understand that place-based learning can incorporate multiple content areas such as mathematical standards and reading standards into her lesson planning. She claimed she will now strive to incorporate multiple standards into one unit versus teaching each standard as an individual lesson.

However, while highlighting that she could integrate many standards into one unit design, Mrs. Pyle also reported that she felt the long-term nature of the placed-based instruction on environmental sustainability usurped too much time in the already limited amount of time she had to cover all of the content standards. She claimed,

I'd rather it be a two week assignment. Uh, only because I have to fit it into my regular curriculum and so I made sure I tried to pull out of project, all of those standards and performance objectives that are required by the state. As opposed to one long term project, where we really get into a lot of detail and may not necessarily- we are all being pressured by following those things that the state and federal government has required of us. I am charged to teach my students, those things that the state... says they must learn. And so I got to be able to fit a project into the curriculum that I am teaching.

Thus, Mrs. Pyle alluded to the fact that she maintained a belief that this type of instruction needed to be added into her regular curriculum. Rather than integrating standards into this unit and therefore reducing her teaching load outside of this project, she added it onto her already filled curriculum. This belief caused her to feel as if there was too much time taken away from the remainder of her curriculum.

With regard to content embedded into the curriculum, Mrs. Pyle noted that she had worked at a local steel mill prior to becoming a teacher and understood the water quality tests

that were conducted to assess the health of the water. Additionally, she reported that she suspected there was pollution coming into the lake by a local steel mill. Thus, it was surprising, given the fact that Mrs. Pyle's had an extensive background in the science content inherent in the study of water quality, that her students' understandings of what the water quality tests meant and how they could be interpreted was so limited. The researchers' realized that most of her teaching time was spent instructing students about how to conduct the tests or how to access data online, rather than how to analyze the results they were getting. Of the six- week unit, an entire week was spent on constructing letters to factory owners to request data – a request that never came to fruition. As well, after the field trip in which students visited to lake to obtain and test samples of the lake water, Mrs. Pyle did not revisit the quantitative results to help support students in interpreting what the numbers in their data tables meant. Instead, she relied on students reading the kit directions to give them an idea of what normal ranges were for each test. The testing kits, then, were not discussed in order to explain what the numbers meant for their town in comparison to surrounding areas. Mrs. Pyle did not realize this connection between her exclusive emphasis on scientific procedures and her students' lack of content understanding, thus, her belief that place-based pedagogy took time away from content instruction was reinforced.

### **Discussion**

By studying this teacher and her students, we learned more about the experiences of teachers attempting to make place-based pedagogy on environmental sustainability integral to teaching and learning. Positively, we noted the potential embedded within the curriculum to connect students with their community and engage them in relevant, authentic inquiry. In terms of the former, we noted throughout the study that students expressed their desire to become stewards of the lake by beginning to voluntarily educate others, but because the curriculum did not incorporate a mission to share the knowledge they had learned about the lake, students had only begun to superficially understand the complexity of the issue. Students understood by the end of the study that the lake was polluted, but could only guess about where the pollution was coming from and how it affected the ecology of the lake. Place-based pedagogy requires educators to think about the concept of place in relationship to education that leads to exceptionally rich and creative avenues of exploration, especially when coupled with a social justice perspective (Greunwald, 2003). Schroder (2006) outlined how schools can meet the challenges by centering on both inquiry and action in local, regional, and global space, studying the culture of nearby places with the study of culture in distant places and shifting the discourse of accountability of to that of place-based accountability. Here, students' attempts to initiate involvement with the community fell short due to lack of response from the steel mill and from local environmental agencies. Students were left to try to make sense of their data, but did not get the opportunity to dialogue with interested parties and generate discussion about potential solutions to the pollution problems. This has implications for teacher education programs focused on supporting teachers to develop placed-based units on environmental sustainability. Such programs, which occur outside of the classroom environment, need to emphasize the development and inclusion of such objectives. In addition, this has implications for teacher education efforts aimed at supporting teachers once they return to the classroom. This support needs to actively address the process of fostering the necessary community partnerships and communication.

Furthermore, we noted that students quickly became involved in asking questions to further their classroom inquiry. We were pleasantly surprised at the enthusiasm with which students probed the teacher and each other about other areas that may have been polluted, who caused the pollution, and what could be done to protect their local lake resource. This suggests that the students valued the place-based nature of the curriculum. However, while student engagement with the social and political aspects of the curriculum was evident, the lack of engagement with content understanding gave us cause for concern. As implemented, Mrs. Pyle guided the students through the place-based curriculum, never assessing if they were constructing the necessary scientific understandings. One possible explanation for this is the lack of emphasis on assessment. Looking back, we realize that Mrs. Pyle's theoretical understanding of place-based pedagogy did not include the importance of formative assessment. The assessment process is a critical component of the inquiry process (Black & Wiliam, 1998; Gitomer & Duschl, 1998). Perhaps if Mrs. Pyle realized the lack of content construction in the early stages, she could have adjusted instruction to assure that the students possessed an adequate grasp on the meaning of their data so as to engage in fruitful dialogue on the topic. This also has implications for teacher education programs focused on supporting teachers' development of place-based units on environmental sustainability. These efforts need to emphasize the development and inclusion of formative assessment as an integral part of the unit. A second possible reason for this is the lack of emphasis on content is a lack of emphasis on it in the curricular design. While Mrs. Pyle was excited about focusing on the social dimensions of the pollution problems at the lake, perhaps her assumptions about the role of scientific literacy in making assertions about swimming in the lake caused for a neglect of the content understanding that was necessary. Focusing teacher education efforts more on data analysis and interpretation is critical in supporting teachers to help students make claims based on observable evidence. This aligns with the national agendas in science and environmental education. Thus, one challenge for teacher education is to better support teachers' integration of content along with the democratic ideals of place-based pedagogy. Content specialists and education specialists can model the infusion of content and pedagogical practices through co-teaching, thus providing an example to which teachers can refer as they develop and critique their own units.

Finally, Mrs. Pyle's belief about the integration of standards and the pressure of high-stakes testing showcased a need to ensure that teachers are able to implement place-based instruction on sustainable topics within, not in addition to, their school curriculum. Bianchini, Johnston, Oram, and Cavazos (2003) suggested teacher programs need to focus more attention on highlighting the connection between science and local interests and issues, enhancing engagement of students in using science toward social and political ends, and empowering teachers to be reflective of how good practice can exist within the culture of high stakes testing. Teachers must be supported in their endeavor to consolidate standards within place-based curricula so as to maximize the content embedded in these long-term projects.

Overall, teacher education efforts need to highlight the connection of urban teachers to their community, while simultaneously supporting the content and integration of standards within place-based instruction on sustainability topics. While our case study with Mrs. Pyle indicated the promise of place-based pedagogy on environmental sustainability in terms of engaging students with relevant inquiry about their place, if we wish to meet the goals of empowerment for students, it is essential that this instructional approach support students'

informed voices in the community. Thus, students should dialogue with their community members about their findings and discuss possibilities for enriching the community through their developing understandings of science. We assert that this type of engagement would necessitate a need for students to deeply understand the meaning of their data so as to enable fruitful dialogue with community members, enable students to pursue their own inquiries to further their understanding of the issue, and allow for a deeper understanding of the complexity of local environmental issues as multiple voices would be heard. Teacher education efforts should include helping teachers embed a community dialogue event into their planned units. In order to support them in this endeavor, these efforts could bring in local stakeholders to facilitate this partnership. Relying on return phone calls and rapid response from community members will not lead to robust and meaningful conversations among schools and community members.

Through systematically studying a teacher's experience with implementing place-based pedagogy on environmental sustainability, we gained a greater understanding of the needs that need to be addressed in teacher education efforts involving groups of teachers outside of the classroom environment, as well as the type of supports needed once they return to their classrooms. Mrs. Pyle's experiences explored with this study are useful for persons seeking to better prepare teachers to re-conceptualize their practice in a manner that puts their students on the path to being informed, critical and active members of their local community.

### References

- Bianchini, J.A., Johnston, C.C., Oram, S.Y., & Cavazos, L.M. (2003). Learning to teach science in contemporary and equitable ways: The successes and struggles of first-year science teachers. *Science Education*, 87,419-443.
- Black, P., & Wiliam, D. (1998). Assessment and classroom learning. *Assessment in Education: Principles, Policy, & Practice*, 5(1), 7-74.
- Bryant, J., Schonemann, N., & Karpa, D. (2010). *Integrating service-learning into the university classroom*. Sudbury, MA: Jones & Bartlett Learning.
- Chinn, P.W.U. (2006). Preparing science teachers for culturally diverse students: Developing cultural literacy through cultural immersion, cultural translators and communities of practice. *Cultural Studies of Science Education*, 1, 367-402.
- Chinn, P.W.U. (2007). Decolonizing methodologies and indigenous knowledge: The role of culture, place and personal experience in professional development. *Journal of Research in Science Teaching*, 44(9), 1247-1268.
- Crawford, B., (2007). Learning to teach science as inquiry in the rough and tumble of practice. *Journal of Research in Science Teaching*, 44(9), 613-642.
- Creswell, J.D. (2012). *Educational research*. Upper Saddle River, NJ: Pearson Education Inc.
- Gitomer, D., & Duschl, R. (1998). Emerging issues and practices in science assessment. In K. Tobin (Ed.), *International handbook of science education* (pp. 791-810). London: Kluwer Academics.
- Glasson, G.E., Frykholm, J.A., Mhano, N.A., & Phiri, A.D. (2006). Understanding the Earth systems of Malawi: Ecological sustainability, culture, and place-based education. *Science Education*, 90(4), 660-680.
- Gruenwald, D.A. (2003). The best of both worlds: A critical pedagogy of place. *Educational Researcher*, 32(4), 3-12.

- Karrow, D. & Fazio, X. (2010). Educating-within-place: Care, citizen science, and ecojustice. In D. Tippins, M. Mueller, M. van Eijck, & J. Adams (Eds.) *Cultural studies and environmentalism: The confluence of ecojustice, place-based (science) education, and indigenous knowledge systems*. New York: Springer.
- Meichtry, Y. & Smith, J. (2007). The impact of a place-based professional development program on teachers' confidence, attitudes, and classroom practices. *Journal of Environmental Education*, 38(2), 15-32.
- Posner, G.J. (1995). *Analyzing the curriculum*. New York: McGraw-Hill.
- Powers, A.L. (2004). An evaluation of four place-based education programs. *The Journal of Environmental Education*, 35(4), 17-32.
- Schroder, B. (2006). Native Science, Intercultural Education and Place-Conscious Education: An Ecuadorian Example. *Educational Studies*, 32(3), 307-317.
- Simmons, P., Emory, A., Carter, T., Coker, T., Finnegan, B., Crockett, D., Richardson, L., Yager, R., Craven, J., Tillotson, J., Brunkhorst, H., Twiest, M., Hossain, K., Gallagher, J., Duggan-Haas, D., Parker, J., Cajas, F., Alshannag, Q., McGlamery, S., Krockover, J., Adams, P., Spector, B., LaPorta, T., James, B., Rearden, K., & Labuda, K. Beginning teachers: Beliefs and classroom actions. *Journal of Research in Science Teaching*, 36(8), 930-954.
- Stake, R.E. (1995). *The art of case study research*. Thousand Oaks, CA.: Publisher
- Smith, G., & Sobel, D. (2010). *Place- and community-based education in schools*. New York, NY: Routledge.
- Sobel, D. (2005). *Place-based education*. Great Barrington, MA: The Orion Society.
- United Nations Educational, Scientific and Cultural Organizations. Education for Sustainable Development (ESD). Taken from <http://www.unesco.org/new/en/education/themes/leading-the-international-agenda/education-for-sustainable-development/>
- Tal, T., Krajcik, J., & Blumenfeld, P. (2006). Urban schools' teachers enacting project-based science. *Journal of Research in Science Teaching*, 43(7), 722-745.
- van Eijck, M. (2010). Place-based (science) education: Something is happening here. In D. Tippins, M. Mueller, M. van Eijck, & J. Adams (Eds.) *Cultural studies and environmentalism: The confluence of ecojustice, place-based (science) education, and indigenous knowledge systems*. New York: Springer.
- World Commission on Environment and Development. (1987). *Our common future*. Oxford, UK: Oxford University Press.
- Yin, R. (1994). *Case study research: Design and methods* (2<sup>nd</sup> ed.) Thousand Oaks, CA: Sage.