P4BL: Linking Phenomena-Based, Place-Based, Project-Based, and Problem-Based Pedagogy to Deepen Learning

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In a world with many critical issues in the news, teachers and students sometimes struggle to find meaning in the content they are expected to teach and learn. The Student Climate Strike, protests related to gun control, teachers' strikes, student walkouts related to Black Lives Matter, and other societal issues are symptoms of young people and educators who are thirsting for more relevance. As educators who are preparing students to co-create a sustainable future, we all must recognize that relevant issues and topics are key to engaging students in learning and taking action. Providing authentic ways for students and teachers to get involved in their communities is an essential feature of Education for Sustainability (EfS) and creating green, healthy, and sustainable schools.

So, how does a teacher choose the best approach to construct relevant and authentic curriculum, in real-time, using real-world issues? We suggest that using best practices and synergies from phenomena-, place-, project-, and problem-based learning applied through a lens of sustainability provides the greatest power to increase student engagement, deepen learning, and breathe life into standards and learning. We call this approach, P4BL. Through examples of curriculum designed in partnership with educators, we will show how teachers have used current events in their world (phenomena), linked to local circumstances, to teach the knowledge and skills required by the standards (place-based) and facilitate student-driven inquiries that require the application of new knowledge and skills in resolving problems in their local community (problem-based learning) or creating a project that documents how a phenomenon affects their community (project-based learning). All while instilling healthy, sustainable attitudes in students and teachers alike.

A simple visual model for P4BL is shown in Figure 1. The critical elements and flow of the learning experiences, which can shape a six- to nine-week P4BL transdisciplinary unit of study, are highlighted. In what follows, we provide a deeper look at how linking these pedagogical practices supports student learning.

While experts in each of the four "P" approaches may advocate for the finer points of an approach, it is our contention that to capitalize on all the best practices requires them to be sequenced to allow the teacher to focus instruction. Leveraging these best practices can lead to authentic, engaging, deep learning and involvement that will produce the student outcomes all of us are looking for. When teachers and students utilize P4BL to identify, investigate, and create solutions to pressing needs in their communities, they generate opportunities for collective action that can make the world a better place. The purpose for learning and student agency, developed through this learning process, can provide students and teachers with hope and ownership of their communities, which is an investment in their future.

Figure 1. P4BL sequence used to deepen learning.

Identifying the Phenomena: Creating the Need to Know

Phenomena-based learning (PhBL) came into vogue in the United States with the advent of the Next Generation Science Standards. PhBL is referenced more frequently in science education to connect science and engineering practices with disciplinary core ideas and crosscutting concepts linked to real-world observations (phenomena). The best practice is for students to identify local phenomena that the students and teacher can use as the central focus of inquiry in the classroom.

It is our recommendation that identifying compelling phenomenon is the starting point for developing curriculum that can support deeper learning in any content area and be the starting point for designing integrated EfS curriculum. Best practices of PhBL include selecting phenomena that:

1. Are relevant to the interests and developmental needs of the student and grounded in the standards being taught;
2. Are based on students' observations in the world around them, things that they "wonder about" and are interested in investigating (phenomena for younger students should generally be very localized while older students can expand their horizons past the school campus and local community);
3. Present events, situations, and interactions that are complex enough to stimulate students' questions and broaden their inquiries (open-ended);
4. Provide opportunities for students to use the "tools" and practices that real scientists, social scientists, and other professionals use;
5. Can be examined from multiple perspectives, including societal and cultural relevance; and,
6. Have the potential for students to design and implement meaningful solutions.

Once the compelling phenomenon, and thus topic, is identified, the teacher needs to determine how best to support student learning and exploration, while at the same time ensuring the conceptual foundations that are defined by the standards are covered. This opens the door to the next phase of curriculum design/instruction, which is incorporating best practices related to high-quality place-based education.

Place-Based Case Study: Building Conceptual Understanding for Deeper Learning

Using the compelling nature of the selected phenomenon, and the content standards to be taught, PBE provides the local context to build background knowledge and develop conceptual foundations. This allows students to make connections to places, people, and things that are important to their daily lives and the lives of their families, thus making their studies deeply engaging and personally meaningful. Teachers become the facilitators of conceptual understanding that students can co-construct with their peers when reflecting on these experiences and synthesizing what has been learned. In this way, content standards are brought to life through experiences that engage all of a student's senses and sensibilities. The resulting questioning and meaning making can direct and focus deeper learning (Seydel, 2017). Best practices related to PBE support the development of conceptual foundations while encouraging the "need to know" of PhBL. For example:

1. Place-based case studies are relevant to the interests and developmental needs of the student and grounded in the standards being taught;
2. Students go out into the field to make observations and collect data and/or resources that can enhance learning;
3. Local experts are utilized frequently to support student learning;
4. The case study exposes students to an expanded definition of "text" that includes the lived experiences of a variety of people, the environment, etc.;
5. Students can see themselves as citizens. The classroom mirrors the real world with democratic processes and student input; shifting roles as teachers learn, students teach, etc.
6. Students learn 21st-century skills (collaboration, communication, problem-solving, technology, etc.) and reflect upon their growth/use of those skills; and
7. The case study answers immediate questions and stimulates deeper questions.

Our experience has taught us that the multiple perspectives and interests that emerge from place-based inquiry create platforms for more robust project- and problem-based inquiries related to ecology, environmental justice, and other issues relevant in a green, healthy, and sustainable school. Without creating the common foundation provided by a place-based case study, the inquiry that occurs next in the learning process through project- and problem-based instruction is often superficial and done for the teacher rather than the community. It is through the place-based case study that students learn what is needed to engage in authentic project and problem design for their community.

Project/Problem-Based Learning: Application of Knowledge and Skills for an Authentic Purpose and Audience

There are a variety of definitions and strategies for project- and/or problem-based learning, yet, in the simplest terms, the thing that they have in common is students designing something for their community. The nature of the project or problem requires students to synthesize information and develop something that meets a need in the community or place. Both project- and problem-based learning often address standards from multiple disciplines as well as skills such as critical thinking, planning, and collaborating.

Best practices for project- and problem-based learning include:

1. Projects or problems should motivate students to learn because the knowledge gained will be useful in solving the problem or completing the task.
2. The project or problem should focus teaching and learning on grade level (or higher) standards and skills, including critical thinking, collaboration, communication, etc.
3. Using an extended inquiry cycle that requires asking questions, defining and prioritizing goals, finding resources, gathering and interpreting data, applying information, evaluating and enacting solutions, and asking more questions or revising the plan.
4. An opportunity for students to take significant responsibility and work as independently from the teacher as is age appropriate.
5. A project or problem that requires or features the use of real-world tools and tasks.

Requiring students to present or create a product that informs the community beyond the classroom.

Incorporating these best practices allows the teacher in the P4BL model to use real-world phenomena, linked to local circumstances, to provide the foundational knowledge and skills required for robust project- and problem-based learning. In P4BL, the authenticity of the project or problem is focused on the needs and concerns of the local community.

Photo: Marathon Venture Academy Staff

Marathon Venture Academy Students

Marathon Venture Academy - The Culture of Climate Change

Marathon Venture Academy (MVA) is a middle school of 135 sixth- through eighth-grade students living in and around Marathon County, Wisconsin. Marathon City is a very small town in north central Wisconsin. The landscape of the surrounding area is over 80% cropland or forest. As suggested by the landscape, the economy relies primarily upon agriculture. In a rural community, conservation of natural resources is part of the culture. It is also, however, difficult to discuss "controversial" topics such as climate change. MVA teachers Gina Smith and Tera Fieri decided to try and tackled it head on by blending science, social studies, and English Language Arts standards to create a 12-week curriculum unit titled "The Culture of Climate Change."

This integrated unit required bundling science,

Key Standards (among others)
Built into "The Culture of Climate Change"

1. NGSS
    a. Disciplinary Core Idea ESS3.D Global Climate Change
    b. Performance Expectation MS-ESS3-5: Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.
2. WI Social Studies Standards
    a. SS.Hist1.b.m: Use multiple perspectives to analyze and explain effects of issues or events within and across time periods, events, or cultures.

Teachers selected CCSS Standards that would allow students to integrate scientific, historical, and traditional ecological knowledge. The following standards, among others, focused the various products and projects the students would undertake.

CCSS.ELA-LITERACY.RH.6-8.7: Integrate visual information (e.g., in charts, graphs, photographs, videos, or maps) with other information in print and digital texts.

CCSS.ELA-LITERACY.RH.6-8.9: Analyze the relationship between a primary and secondary source on the same topic.

CCSS.ELA-LITERACY.RST.6-8.9: Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic.

social studies, and English Language Arts standards together in a unique way while leveraging a local phenomenon to engage students in learning about climate science. While studying with local Ojibwe elders, students learned how climate change was having a critical impact on the habitats and sacred rituals of collecting an important staple food, wild rice. MVA students then explored how changing weather and climate patterns were impacting their own families' traditions and livelihoods (Fieri and Smith, 2016; Connect, n.d.).

The teachers identified key standards (see Sidebar) to identify the phenomenon and place-based case study with which to frame the unit.

In this P4BL unit, the phenomenon that focused the curriculum design process was climate change – specifically, its impact on local culture and community. The first place-based case study the teachers designed was on wild rice, a staple food and cultural influence for the Bad River Band and Red Cliff Band of Ojibwe people in Wisconsin, and its connection to climate change. Teachers from MVA participated in the "Gikinoo'wizhiwe Onji Waaban" (Guiding for Tomorrow) or "G-WOW" training program to learn how climate change is affecting the environment, people, cultures, and economies of the Ojibwe people living around Lake Superior. They used the G-WOW curriculum with their students and took them to an overnight Coastal Climate Camp at the Northern Great Lakes Visitor Center in Ashland, Wisconsin. This experience focused on the importance of wild rice to the Ojibwe culture, and how climate change has affected the rice's growing region over the past 100 years. As students deepened their understanding, questions emerged about what was happening in other countries and cultures. This led students to use a global lens to examine stories from climate change witnesses around the world in their social studies class. In science, students researched local climate data from the Wisconsin Initiative on Climate Change Impacts database to understand changes over time and participated in bi-weekly phenology journaling in the prairie gardens at their school. In English Language Arts, students interviewed family members to establish and compare their families' traditional environmental knowledge. These interviews served as the basis for written arguments that students developed about how their families were being affected by climate change.

To demonstrate the new knowledge and skills that they had acquired, each student completed a project, entitled "My Climate Story," collectively Our Climate

The Culture of Climate Change	
Phenomena	1) Climate change 2) Cultural identity
Place-Based Case Study	1) G'WOW Lifeways 2) Geography of Climate Change
Project/Problem-Based Inquiry	Photo Collage Documentaries: Our Climate Stories
Public Reporting and Sharing of Learning	Our Climate Stories https://www.facebook.com/marathonventure/videos/705186373210901/ https://www.facebook.com/marathonventure/videos/292951811393667/ https://www.facebook.com/marathonventure/videos/2116768578389047/ https://www.facebook.com/marathonventure/videos/300708093860357/

Stories. These projects were documentaries that merged students' climate arguments and personal narratives about traditions that identify the climate as an "asset" in their culture with their understanding of climate change over time, using local climate data to demonstrate the impact climate change has on that "asset." The documentaries were showcased at a celebration at a local college and at the Chicago Botanical Gardens. In addition, students created a documentary of the curriculum unit, which is now part of a repository for exemplary place-based instruction.

McKinley Elementary School - Too Many Crows on Campus

In contrast with the integrated unit described above, McKinley Elementary School fifth-grade teacher Katherin Konomi wanted to use a place-based NGSS-focused unit of study centered on disciplinary core ideas 5-LS2.A interdependent relationships in ecosystems and 5-LS2.B cycles of matter and energy transfer in ecosystems. Wondering how to engage her students in these topics, she began by taking them out onto the school's Burlingame, California campus, located on San Francisco Bay, south of San Francisco in the midst of Silicon Valley.

While exploring the school's campus, students were curious about the large number of crows around the outdoor tables and in the areas where students eat lunch. After learning a bit more about the growing number of crows in the area, Ms. Konomi decided that this phenomenon, "too many crows on campus," was compelling enough and had all the elements necessary to engage her students in learning more about food chains and food webs.

To ground her first place-based case study, she designed a sequence of lessons to help students understand where their lunch food comes from and how it gets to them. They created a food word web to trace each menu item back to its original ingredients. This process helped students identify that almost all the food we eat can be traced back to plants. In subsequent lessons students compared how plants, animals, and people use and obtain energy and resources. They also learned about the roles of producers, consumers, and decomposers in a food web.

After developing a foundation in the disciplinary core ideas, Ms. Konomi's students were ready to take on a deeper problem-based study regarding the multitude of crows on campus. Students began to research crows: where they live, what they eat, and their role in an ecosystem; why crows come to the

Marathon Venture Academy Students

McKinley campus; the McKinley community's role in bringing crows to the campus; and the effect of crows on the campus. By focusing the inquiry on a local "problem," students deepened their ecological knowledge and discovered "organisms can survive only in environments in which their particular needs are met" (NGSS LS2.A).

Based on their understanding, students developed a hypothesis of what they expected would happen if food were left in the outdoor lunch area and designed a way to test their hypothesis. For four days, students collected data and investigated the crows after lunch. On two of the days, custodians left lunch waste on the tables and students counted the

Photo: Marathon Venture Academy Staff

number of crows that came. On the other two days, students made sure everything was completely clean when lunch ended and then observed the number of crows. After their investigation, students revised their models and predictions based on their observations.

Throughout this unit of study, students utilized several of the NGSS science and engineering practices through student-designed investigations and by creating models representing how crows are connected to the natural system and human social system on campus. Ultimately, following their investigation and modeling of the problem, students began to recognize that they were the cause of the "crow problem," not the crows. After all, it was the students who were the ones dropping their lunch materials and supplies on the tables and ground.

The culminating activity for this unit of study provided students with a path for becoming active citizens and stewards of the environment and place where they live. They undertook an environmental service-learning project to come up with solutions about how students in all grades could reduce the amount of lunch waste on campus and the number of crows after lunch hours.

The experience with this place-based approach provided students with a real-world, local context for developing their knowledge of the three dimensions of NGSS instruction. At the same time, it gave them the experience of identifying a problem in their local environment, investigating the causes and effects, developing a strategy for resolving the problem, and implementing their solution.

Seven Generations Charter School – Disappearing Bees

Seven Generations Charter School, a K-5 school in Emmaus, Pennsylvania, was founded in 2009 and is committed to an educational model and curricular framework called Using the Environment as an Integrating Context for Learning, which was developed by the State Education and Environment Roundtable (Lieberman, 2013). The school's approach engages students in problem-based experiential learning opportunities that connect students to nature and their community through hands-on experiences both inside and outside of their classrooms. This approach connects directly to state standards like the problem-based learning approach in California.

Several years ago, the fifth-grade teaching team of Alison Panik and Brook Graves developed a community-centered, problem-based unit of study

focused on pollinators and the important role they play in maintaining local ecosystems at the school, in neighborhood gardens, and in local, natural areas. Panik and Graves designed units of study that integrated standards and instruction from several disciplines including science, history-social science, math, and English Language Arts.

With the standards in mind, the teachers had their students work with farmers and community members in the agricultural region surrounding Emmaus who had been noticing (phenomenon) a declining population of pollinators for several years. As the students and teachers engaged in researching the community-based problem of "disappearing bees" they noticed their students getting more and more engaged in the challenges of delving into the cause of this problem and possible solutions. Building on the discipline-specific knowledge they had built, the students' investigations led them to conduct a community-based investigation using science and engineering strategies and, eventually, design their own environmental service-learning project to address the local pollinator problem.

Every year since the project started in 2011, the depth of instruction in these two classrooms has built on the knowledge of their predecessors. Initially, students researched hive designs and decided to build a "top bar hive" because it replicates the natural hive structure. The fifth-graders built their own hives, collected funds to get their bees, and organized a "Bee Movie Night" to raise local awareness of pollinator decline. In subsequent years, often aided by students in other grades, the fifth-grade students continued to care for the hives and established school gardens to provide food sources for the school and insects and serve as outdoor learning locations. To further expand understanding and continue working on the problem of declining pollinators, students began consulting with local master gardeners. With guidance from Rodale Press (a neighbor to the school), students expanded on the original solution of building hives by designing a pollinator-friendly habitat garden that included a vertical garden structure. Always wanting to do more, students raised more funds by selling harvest sacks and snack bags, which allowed them to purchase more flowering plants, fruit trees, blueberry bushes, and raspberry bushes for the garden.

Over the years, instruction and campus/community investigations and learning experiences expanded to focus on state standards and environmental context-based learning objectives. These objectives addressed local natural and social systems; principal components, processes, and interactions within local natural and social systems; interactions among local natural and social systems; effects of natural and social systems interactions on the school and community; civic responsibility and teaming skills; and developing and implementing plans for communicating and working with the school community and the people of Emmaus.

With a focus on standards-based, problem-based, and place-based instruction; learning with a local, real-world environmental context; and opportunities to identify, investigate, and design solutions, Seven Generations students have grown academically, learned how to address real-world problems, and become citizens capable of making reasoned decisions for themselves and their environment.

Summary: Incorporating P4BL into Your School Curriculum

As you explore the implications of this P4BL model for your green, healthy, and sustainable school or district, it is important to acknowledge the recursive relationship between teaching and learning. Because U.S. K-12 schools are held accountable for how students perform on high-stakes tests, it is important that teachers select phenomena that are linked to content standards and engage students with place-based case studies that help them develop the conceptual foundations for deep, rich, community-based project- and/or problem-based learning. When teachers and students utilize this P4BL process to identify, investigate, and create solutions to needs in their communities, their schools transform from places to learn the 3Rs, to places where active, engaged citizens are nurtured and encouraged to make the world a more sustainable place.

Works Cited

Buck Institute. (n.d.) What is PBL? *PBLworks*. Buck Institute for Education. Retrieved from: https://www.pblworks.org/what-is-pbl

California Department of Education. (2018). *2016 Science framework for California public schools: Kindergarten through grade twelve*. Sacramento, CA: California Department of Education.

Cloud, J. (Ed.). (2017). Education for a sustainable future, benchmarks: For individual and social learning. *Journal of Sustainability Education*. Retrieved from: http://www.susted.com/wordpress/wp-content/uploads/2017/03/EfS-Benchmarks-1.1a.pdf

Connect. (n.d.). Marathon Venture Academy. *Connect: Community + Climate + Action*. Retrieved from: http://www.connectcca.org/projects/marathon-venture-academy

Demarest, A. (2015). *Place-based curriculum design: Exceeding standards through local investigations*. New York, NY: Routledge

Fieri, T. and Smith, G. (2017). Teaching climate change in a public school setting. *GreenNotes*. Green Schools National Network. Retrieved from: https://greenschoolsnationalnetwork.org/teaching-climate-change-public-school-setting/

Finnish National Board of Education. (2016). National core curriculum for basic education 2014. Helsinki, Finland: Finnish National Board of Education.

Getting Smart. (2017). *What is place-based education and why does it matter*. Getting Smart. Retrieved from: https://www.gettingsmart.com/wp-content/uploads/2017/02/What-is-Place-Based-Education-and-Why-Does-it-Matter-3.pdf

Lieberman, G. (2013). *Education and the environment: Creating standards-based programs in schools and districts*. Cambridge, MA: Harvard Education Press.

Powers, A. (2004). An evaluation of four place based education models. *Journal of Environmental Education*, *35*(4) pp. 17 - 32. Retrieved from: http://www.peecworks.org/PEEC/PEEC_reports/01795C87-001D0211.0/Powers%20JEE%20article.pdf

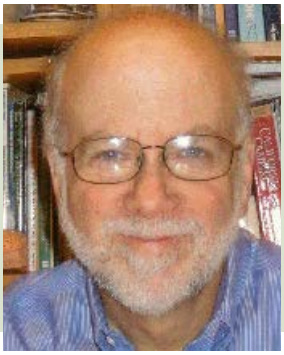
Sahlberg, P. (2011). *Finnish lessons: What can the world learn from educational reform in Finland?* New York, NY: Teachers College Press.

Sahlberg, P. (2015). Finland's school reforms won't scrap subjects altogether. *The Conversation U.S.* Retrieved from: http://theconversation.com/finlands-school-reforms-wont-scrap-subjects-altogether-39328

Seydel, J. (2017). Place-based education opens doors to authentic learning. *GreenNotes*. Green Schools National Network. Retrieved from: https://greenschoolsnationalnetwork.org/place-based-education-opens-doors-authentic-learning/

Smith, G. (2016). The past, present, and future of place-based learning. *Getting Smart*. Retrieved from: https://www.gettingsmart.com/2016/11/past-present-and-future-of-place-based-learning/

Sobel, D. (2005). *Place–based education: Connecting classrooms & communities*. 2nd Edition. Great Barrington, MA: The Orion Society.



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