

## John Barell

John Barell, Ed.D., is professor emeritus of Curriculum and Teaching at Montclair State University, Montclair, New Jersey, and a former public school teacher in New York City. Since 2000, he has been a consultant for inquiry-based instruction and creation of science/social studies networks at the American Museum of Natural History in New York City in collaboration with the

International Baccalaureate Organization. For most of his educational career, he has worked with schools nationally to foster inquiry, problem-based learning, critical thinking, and reflection. He is the author of several books, including *Teaching for Thoughtfulness: Strategies to Enhance Intellectual Development*, *Developing More Curious Minds*, *Problem-Based Learning—An Inquiry Approach*, and *Why Are School Buses Always Yellow?*

In this chapter, Barell shows that problem-based learning is an ideal way to develop 21st century skills. He describes how teachers shift their standards-based curriculum from direct instruction of passive students to active engagement of problem solvers and question askers. His concrete examples illustrate ways problem-based inquiry can be adapted for meaningful use with students of all ages, talents, and challenges.

## Chapter 8

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# Problem-Based Learning: The Foundation for 21st Century Skills

John Barell

Recently, I noticed several magazine advertisements that summarized for me why it is so important to challenge today's students to become skillful problem solvers. The first advertisement depicted a serene Antarctic scene: an iceberg looking like a tall ship, high bowsprit facing into the winds, with surrounding ice in wonderful shades of blues and whites. The ad was by Kohler, a manufacturer of plumbing supplies, telling readers that if they substitute their usual shower head spraying 2.75 gallons of water per minute for one using only 1.75 gallons per minute, they can save 7,700 gallons of water per year (Kohler ad, 2009).

This advertisement led me to consider some current issues and critical problems that need solving in the wider world, such as conservation of natural resources, the United States' overreliance on foreign fossil fuels, and the need to develop alternative sources of clean, renewable energy.

In more ads for U.S. manufacturers, I noticed the following headlines:

- The word “inoperable” now applies to far fewer brain tumors. (Cleveland Clinic ad, 2008, p. 19)

- The world is growing by more than 70 million people a year. So is that a problem, or a solution? (Chevron ad, 2008, p. 36)
- How can we squeeze more food from a raindrop? (Monsanto ad, 2009, p. 3)

Obviously, these companies want us to purchase their products and services and may just be manipulating our concerns for profit. But they do urge us to recognize the significant challenges we all face in today's world, challenges requiring us to innovate, change, take risks, recognize problems, and imagine alternative futures.

In the 21st century, we need all of the skills that have marked humankind as the creators and sustainers of cultures, the innovators of technologies, and the designers of ways of living and governing. These skills, which are more crucial now than ever before, include “critical thinking, problem-solving, collaboration, creativity, self-direction, leadership, adaptability, responsibility [and] global awareness” (Walser, 2008, p. 2). To this list, I add the significant skill of inquiry.

### **But What Makes the 21st Century Special?**

Yes, it is true; humans have always engaged in problem solving and critical and creative thinking. History is replete with examples:

- Early hominids figuring out how to capture, kill, and consume prey much larger than themselves while using only stone tools
- Socrates confronting the youth of Athens with what he called “perplexities” to challenge their thinking
- Leonardo da Vinci and Michelangelo creating masterworks that revolutionized the old, medieval ways of seeing
- Rosa Parks challenging segregationist practices by refusing to move to the rear of the bus in Montgomery, Alabama, on December 1, 1955
- Sally K. Ride, America's first woman astronaut, determining what failed during the *Columbia* shuttle flight on February 1, 2003

But what makes the 21st century special? What are the new and threatening problems we face, both domestic and foreign, that

necessitate more attention to how we think and solve problems? In addition to the complexities of energy production and conservation, preserving the planet, and fighting terrorism, we face almost intractable situations when it comes to providing health care, ensuring equity within all of our educational and judicial systems, and figuring out how to preserve our financial markets after the worst economic meltdown since the Great Depression.

The increased complexity of these challenges makes it all the more important that we do a better job preparing our students as problem solvers. We must provide students with improved strategies to help them deal with problems—this is what holds the most promise in our education system. Problem-based learning (PBL) is one such strategy.

The PBL approach often raises serious questions among those who are first exploring this option:

1. What is PBL?
2. What are the key elements of PBL?
3. What does PBL look like in the classroom?
4. Why start with a problematic scenario?
5. Why is inquiry important within PBL?
6. How do we develop curricula for PBL?
7. How do we enhance PBL with 21st century technology?
8. What do we know about the effectiveness of PBL?

## **What Is PBL?**

When discussing problem-based learning, we must first explore the meanings of the word *problem*. Problem-based learning is something different, but not wildly so, from what many students are experiencing today when they answer short-term “problems” at the end of textbook chapters. In math and science, students work on individual problems, often with answers in the back of the book. On a larger instructional scale, students sometimes contend with “problems” that call for them to find solutions, such as how to improve the school playground or the water quality of a neighborhood pond or stream.

Some teachers use problematic situations in literature and history to organize the curriculum. For example, in one third-grade classroom, I witnessed two excellent teachers read *Franklin in the Dark* by Paulette Bourgeois (1986). This is the story of a little turtle, Franklin, who is afraid of “small, dark places” like his shell. So he goes on a quest searching for solutions. Before the end of the story, the teachers asked the students, “What do you think Franklin’s problem is?” and “How would you solve it?” These “problem” questions engaged the students in thinking about Franklin’s solutions as well as their own.

*Problem-based learning* goes well beyond these short-term instructional instances or simple questions. It encompasses a rethinking of the entire curriculum so that teachers design whole units around complex, “ill-structured” problematic scenarios that embody the major concepts to be mastered and understood. By “ill-structured” or “ill-defined” I mean the realistic, authentic problems—such as pollution of the planet and feeding the hungry—that are so complex, messy, and intriguing that they do not lend themselves to a right or wrong answer approach; on the other hand, “How far does an automobile travel in 3.5 hours going 60 mph?” would be an example of “well-defined” problem because there is a right answer.

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While engaged in the unit, students will ask good questions, conduct purposeful investigations, think critically, draw conclusions, and reflect until they arrive at a meaningful solution. In addition, such units no longer are limited in use to children with high aptitudes, but are used with students of all ages and abilities, including those with special needs.

From this perspective, PBL challenges teachers to reconstruct their understanding of problem solving. It takes them from solving homework problems in a single lesson to using advanced thinking skills throughout a unit designed around in-depth problem solving. To accomplish this, PBL requires a complete rethinking of the roles of teachers and students, as well as the goals of educational programs. PBL teachers not only present information, but they also learn along

with students and help them become more skillful problem solvers. In this capacity, students are no longer passive recipients of knowledge; they are decision makers about the nature and structure of their own learning as they work their way through the problem-based unit.

### **What Are the Key Elements of PBL?**

Cheryl Hopper—a former ninth-grade teacher in Paramus, New Jersey, who will be discussed in more detail in the following section—designed a sample unit that includes ten key elements of problem-based learning:

1. Real-world problems that foster inquiry and embody key concepts like change, equality, and environment
2. Choices about content as well as ways to learn and share understandings
3. Objectives reflecting the highest of intellectual challenges, including the need to pose questions, conduct purposeful research, think critically, make decisions, and draw reasonable conclusions supported with evidence
4. Experiences in small-group collaboration such as listening, reasoning together, and building upon each others' ideas
5. Feedback students receive from classmates and teachers during rehearsals of final findings; such feedback—"What we liked and our questions"—is most helpful and reflects what occurs in actual life experiences
6. Occasions to revise, modify, and elaborate on findings
7. Engagement in planning of, monitoring of, and self-reflection on work, progress, and results
8. Opportunities to obtain pre-, formative, and summative assessment information
9. A clear and easy-to-follow curricular structure centered on authentic problems and inquiry
10. Teachers and students sharing control of decision making, teaching, and learning

## **What Does PBL Look Like in the Classroom?**

Cheryl Hopper’s ninth-grade classroom was no ordinary experience for her students. Cheryl was the kind of teacher who announced on the first day, “There are no rules here. There are very high expectations.” Students knew immediately that they were in for an exciting and challenging journey through world history and geography. What they didn’t know was that they would soon experience the key elements of problem-based learning, especially real-world problems, inquiry, and assessment feedback—elements that would fully engage them in their learning.

### **The Problem Scenario**

At the beginning of an interdisciplinary unit exploring the geography, politics, economics, history, art, and religion of Africa, Cheryl put her students into the roles of problem solvers. She used this scenario:

You are an African nation that desires a substantial loan from the World Bank. Your goal is to convince the World Bank that your country’s needs are great and you deserve a loan. The World Bank has a limited amount to lend and many other countries are asking for loans. Therefore, you must prepare a strong case for receiving a loan and be able to defend your need for the money. (Barell, 2003, p. 145)

Imagine being a student confronted with this challenge of not only learning about an African nation of your choosing, but also conducting extensive research about the nation’s natural resources, history, and culture. Imagine having to identify a country’s most pressing economic, political, and health needs; devise a plan to meet them; and then present your plan to the World Bank—in this case, Mrs. Hopper herself. This is not passive learning.

### **Cheryl’s Guided Inquiry**

For this unit, Cheryl used a variation of the structured approach to inquiry known as KWHLAQ (figure 8.1). This organizing framework provides a tool to guide student-generated questions within the unit.

- K** What do we think we already *know*? Explore prior knowledge.
- W** What do we *want* and need to find out?
- H** *How* will we proceed to investigate our questions? *How* will we organize time, access to resources and reporting? *How* will we self-assess our progress (such as with a scoring rubric)?
- L** What are we *learning* (daily)? And what have we *learned* at the end of our investigations?
- A** How and where can we *apply* the results of our investigations—to this and other subjects/to our daily lives?
- Q** What new *questions* do we have now? How might we pursue them in our next units?

Source: Barell, 2007a, p. 85.

**Figure 8.1: The KWHLAQ approach to inquiry.**

After two days of showing students slides featuring different aspects of African culture, geography, and government, Cheryl asked them to identify what they thought they already knew about Africa. They made a graphic web of the comments that reflected their prior knowledge as well as what they saw in the slide show. For example, the graphic organizer students created (“What do we *think* we already know?”) included concepts such as “language (linked to diversity), apartheid (Nelson Mandela), deserts (Kalahari), art (music), poaching, and second largest continent.” Cheryl used the slides to awaken their background knowledge about Africa and, most likely, to create new knowledge and a heightened sense of curiosity and awareness.

After the students webbed out what they *thought* they knew, Cheryl challenged them to identify what they needed to know if they were to understand the continent, its countries, and the varied cultures.

Here are some of Cheryl’s students’ questions:

- How and why did powerful kingdoms emerge in Africa, especially West Africa?
- How do geographical features account for the cultural diversity of the continent?
- What were the effects of European rule? Of apartheid?

- How have traditional patterns of life stayed the same and how have they changed?
- How does the art of Africa reflect its cultural diversity?
- What is imperialism?
- Why did Europe carve up Africa into colonies?
- What were the effects of European rule? (Barell, 2003, p. 139)

When we afford students opportunities to respond to “What do we want and *need* to find out?” we are challenging them to think of themselves as young professionals, in this case historians, cultural anthropologists, linguists, artists, social scientists, geographers, and economists. Casting students in these roles lends more authenticity to the problematic scenario. It is possible, as one teacher mentioned to me, that “some students don’t *want* to know very much!” Thus, we challenge them to think of themselves as professionals in a situation requiring solutions.

Cheryl then helped students analyze and collate these questions, searching for commonalities and ways to connect one to another. One result of this process was that students’ specific questions now more closely resembled some of the unit’s general essential questions that focused on the history of colonialism (“How do colonial empires develop?”), the growth of different cultures (“What factors influence the growth of various and different cultures?”), and influences of geography (“How does geography affect the history and culture of a continent or country?”). When students finished these tasks, Cheryl used their responses to guide the development of the unit. Using questions from the KWHLAQ approach, she asked, “How will we go about finding answers to our questions?” and “How will we structure and manage our class time and access to resources to solve the problem?” (see figure 8.1, page 181).

Once they classified and organized their questions, they selected questions to work on and formed themselves into different investigative groups. Working in teams, they conducted research, planned out daily lessons to teach the class, and involved the teacher in appropriate roles. Each team taught a lesson and designed a role within the

lesson for Cheryl. She was still in charge of the entire unit, but her students assumed more ownership of the process. Through a variety of activities, like becoming docents at a local African art museum, the students gained more control of their own learning while discovering answers to their own—and to the unit’s—essential questions.

When watching Cheryl interact with her students during the planning of their lessons, I saw another major benefit of the PBL inquiry approach: students collaborate as they decide how to best share their new knowledge with their peers. They learn what it takes to make knowledge meaningful. And one of the major positive effects of this approach is students’ taking on more responsibility for their own learning. They are not merely sitting back and soaking up lots of factual knowledge to be repeated on a summative assessment at the end of the unit. Rather, they are collaborating, conducting research, analyzing findings critically, and drawing individual and group conclusions—all requisite life experiences.

### **Final Assessment**

With a well-written problematic scenario like Cheryl’s, teachers have the potential for a final assessment that provides students with multiple opportunities and ways to demonstrate their understanding of key ideas and concepts. Cheryl’s unit culminated in small groups of “international developers” making their cases for setting up a hospital or constructing other needed buildings. They used written and oral reports, PowerPoint presentations, interviews, newspaper articles, and various art forms (pictures, maps, creative writings, and the like)—not merely five-paragraph expository essays.

After the students presented their initial group requests, Cheryl provided an opportunity for questions and direct feedback, which is an essential element in authentic assessment (Wiggins, 1998). Cheryl also facilitated needed adjustments and improvements before final presentations. To guide her feedback, Cheryl used a rubric created with the students that stressed solving problems; making sound

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decisions; organizing and presenting cases in a logical, convincing fashion; and responding to questions.

The feedback Cheryl provided did not coddle the students. For instance, after a student presentation about building a health facility, fellow students commented, “I think you’re being rather unrealistic. I don’t think you can build a hospital for the amount of money you’re asking for. Have you considered other variables, such as the costs of cutting through the forest with the needed energy, supplies, and staffing?” These comments and responses reflected the deepening of their knowledge and understanding. As such, they served as assessments on what students did and did not understand during the entire process. And, again, this penultimate form of feedback provided the young urban planners with information and points of view they needed to culminate a final presentation.

After the final presentations, Cheryl asked all students to reflect on their learning processes (the Q of the KWHLAQ). Here are some of their responses:

- [When] I compared my country to a state in the U.S. or another developed country about the same size, it was easier for the World Bank to understand our problems.
- The information was easy to get, but we had to focus on the problems, and that was hard.
- I ended up with the question of why people continue to reproduce if their lives are so hard. (Barell, 2003, p. 146)

These examples show students completing the last two elements of the KWHLAQ approach (see figure 8.1, page 181). Here students are applying what they’ve learned as well as continuing on with questions about the future. In a well-designed PBL unit, further questions about such complex issues are always expected.

Cheryl’s African unit presents the highest level of intellectual challenge. In six weeks, her students not only gathered significant information, but also made critical choices as they figured out the needs of a country and how best to resolve its problems. As she subsequently told me, “Their questions met all of my unit goals (in the form of essential questions).”

Imagine how different this unit would have been with the “Open your textbook and let’s start reading and remembering” approach!

### **Why Start With a Problematic Scenario?**

A well-designed problem scenario includes two important ingredients that ensure students learn from the PBL unit. The first is delineation of a complex problem embedding the core concepts the students will be studying. The second is an outline of the authentic assessment parameters that stipulate what students are to understand about the concept. Remember that the problems designed by the teacher (perhaps with students) will be clear but will also reflect the complex, ill-defined, and messy nature of real-world dilemmas.

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A problematic scenario embodies the essential elements of the unit so that as students inquire and discern, they encounter the ideas and concepts the teacher wants them to think deeply about; this process introduces the core content of the scenario. Here are several other examples of problematic scenarios, each from a different grade level, that reflect these design principles.

#### **Ocean Life: Grade 3**

*You are responsible for finding a way (or ways) to stop the destruction of the ocean so that the animal or plant life that you have chosen and researched can remain a part of the ocean community. You must find a way to show that your method of saving the ocean will help not only the species that you have chosen, but will also help to preserve all of the living and non-living things that the species is dependent on, and all of the things that are a part of the ocean community that depend on it (interdependence). (Catrupi, as cited in Barell, 2007b, p. 46)*

This scenario could start several different units on ocean life, ecology, human actions, or the environment. Notice the charge in the first sentence: identify the core problem and figure out how to

solve it. Students first become familiar with current conditions in the ocean—that life forms such as coral reefs are whitening and dying. Then they identify which problems to focus on and work toward resolving those problems.

In the second sentence of the scenario, the teacher challenges her students to present information that demonstrates their understanding of how all living things are interdependent. She sets the demands of authentic, summative assessment with reporting criteria that tell students from day one what she expects them to do and to learn.

### **Community Building: Grades 6–8, Special Needs**

*A major widget factory has announced that they are breaking ground within an undeveloped area. The factory will bring in a diverse population. You are a committee member that has the responsibility of determining and developing the community and the necessary facilities needed to make [the factory] functional . . . e.g. law enforcement . . . education . . . health . . . and emergency services. (Desotelle & Lierman, 2000, p. 2)*

This community-building project for middle school students with special needs requires extensive research on what a community is, what services it provides, and what long-range planning is required. These students must develop their plans within a strict budget. After their presentations, their teacher and peers question the conclusions and provide feedback. How different is this from the usual special needs experience full of repetitious, boring worksheets?

### **High School: Literature**

*You are authors for a new publication on contributions of 19th century women authors. Readers are interested in the importance of the ideas of Anthony, Woolf, Austen, Chapin, the Brontës, Stanton, Stowe, and knowing what they might say about issues today. Readers will highly value your ability to state these 19th century authors' views clearly, analyze their importance, and make reasonable applications to and comparisons with one major current issue. Reasonable comparisons will be judged*

*by logic, appropriateness, extensiveness of relationships, and drawing your own conclusions.* (Adapted from Royer, 2000)

In this scenario, the teacher challenges students to conduct extensive research on one author, analyze her work, and predict (based on contextual evidence) what her stand on a contemporary issue might be. In the final sentence of the scenario, the student authors receive a set of criteria for reviewing each article. As in all well-formed scenarios, these criteria outline clear expectations for the treatment of the content.

Each of these problematic scenarios presents a significant and well-defined challenge requiring students to familiarize themselves with the subject, pose meaningful questions, think critically, and draw reasonable conclusions. According to Kim Nordin, these scenarios add “focus, drive and excitement to the unit” (personal communication, January 15, 2007).

### **Why Is Inquiry Important Within PBL?**

We can have students solving problems, but to do so without a strong emphasis on inquiry as a curricular priority is a less than sound practice. As stated previously, inquiry is the driver of the complex thinking processes we have been engaged in since the dawn of consciousness: What lies beyond the hill? How will we feed, clothe, and protect ourselves? What do those lights in the sky mean? Today, with all the challenges we face in terms of providing equal access to education, employment, health, energy, security, nutrition, and growth opportunities, it seems logical that we highlight the role of inquiry.

The school board in Greenwich, Connecticut, has done just that. Their “Vision of the Graduate” proclaims that the following are the competencies students must have (assuming acquisition of content knowledge):

- Pose and pursue substantive questions
- Critically interpret, evaluate, and synthesize information
- Explore, define, and solve complex problems
- Communicate effectively for a given purpose

- Advocate for ideas, causes, and actions
- Generate innovative, creative ideas and products
- Collaborate with others to produce a unified work and/or heightened understanding. (Greenwich Public Schools, 2006)

If students graduate from this school system and others, they should be ready for college and life as responsible citizens.

Speaking on the nature of college education, Leon Botstein, president of Bard College in New York, made this statement about the importance of problem-solving skills for college students:

The primary skills [learned in college] should be analytical skills of interpretation and inquiry. In other words, know how to frame a question. . . . You should not be dependent on the sources of information, either provided by the government or by the media, but have an independent capacity to ask questions and evaluate answers. (as cited in Flaherty, 2002, p. 4A27)

Botstein sees higher learning institutions focused on a single, clear goal: to empower their students to be thoughtfully inquisitive. He concluded by saying, “A college education has to engender a lifelong habit of curiosity, as opposed to becoming more convinced that you are an authority” (as cited in Flaherty, 2002, p. 4A27).

### **What Is the Role of Inquiry in PBL?**

One of the benefits of a PBL approach using the kinds of scenarios outlined here is the opportunity for students to ask a starter question that checks their prior knowledge for accuracy: “What do I *think* I know about this situation?” The use of *think* calls for students to recognize that what they “know” might also include some information they aren’t quite certain of. It is, therefore, important to acknowledge what is accurate as well as what is in doubt.

Author Arthur Costa, when discussing the importance of asking what we *think* we know, said, “It is my belief that what we have in our memories is a mixture of fact and fiction, of understandings in

accordance with facts and down-right misunderstandings” (personal communication, June 25, 1998).

A second benefit comes with the *W* of KWHLAQ: “What do we want and need to find out?” This question asks students to identify gaps in their knowledge and understanding and taps into what they are genuinely curious about. It tells what they will need to know and find out in order to meet the challenge of the problematic scenario. Again, when asking our own questions, we are acting as young professionals, as scientists, literary critics, artists, historians, mathematicians, nutritionists, and physical educators.

### **Inquiry and Critical Thinking**

The question “What do we need to determine?” demands that students step back, take a deep breath, and ask questions that give them important information as well as lead them toward generating viable solutions for their problematic scenarios. It is even more beneficial when PBL teachers generate lists of key questions and post them around the room for everybody to reference if they encounter a problematic scenario in other classes, in the news, or in their personal lives.

For example, consider these claims:

- We will have deficits as far as the eye can see.
- It is very likely that humans have largely caused global warming.
- “The artificial sweetener aspartame has been proved responsible for an epidemic of cancer, brain tumors and multiple sclerosis” (Mikkelson & Mikkelson, 2007).

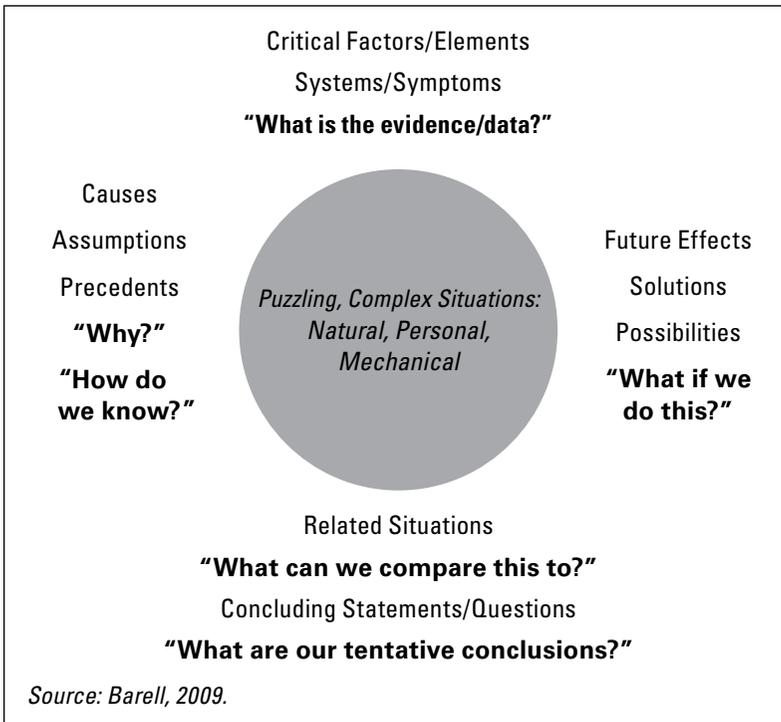
What fundamental questions should we ask? What do we need to know about each in order to accept or believe it?

We should ask about sources, evidence, assumptions, definitions, and slant or bias. As students encounter more of these kinds of claims and judgments, they ask questions to learn more before drawing their own conclusions (Barell, 2009). In this way, PBL not only strengthens the students’ question-asking skills, but also encourages the transfer of those skills beyond the immediate unit.

The question framework (figure 8.2) presents another questioning model used to promote inquiry skills with students from grade 4 upwards. The framework, similar to KWHLAQ, also provides a generic set of questions to pose about complex, perplexing situations. It allows the teacher to ask questions that help students examine a strange or puzzling situation. At the top, basic information is assessed; on the left, students search for causation; at the bottom, they compare; and on the right, they project into the future. To close, they clarify their tentative conclusions.

### How Do We Develop Curricula for PBL?

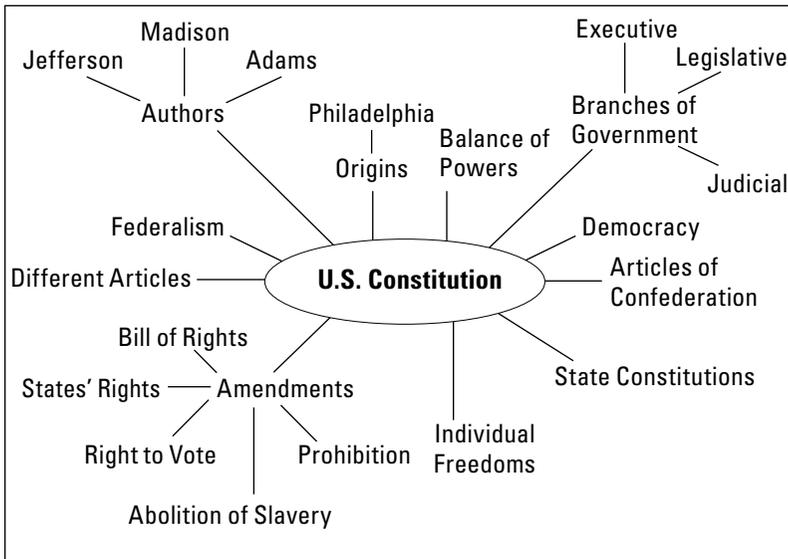
Teachers often ask, “How can we prepare and plan for students’ questions?” This question led me back to my own curriculum development roots. I formulated this step-by-step process to help clarify how teachers should organize units for problem solving and inquiry.



**Figure 8.2: Question framework.**

The following can be completed during planning time, alone, or with colleagues:

1. Identify a topic. Here teachers should refer to their district’s curriculum as well as the state or provincial standards for what concepts and ideas they wish to present to their students.
2. Map out the concept. For example, if the topic is the U.S. Constitution, the teacher might map it as seen in figure 8.3.
3. Consult state and local standards to determine which of these subtopics you need and/or must include. Here in New York at the middle school level, students are expected to know and understand the origins and reasons for developing the Constitution; the forms and functions of three branches of the U.S. government; the Bill of Rights; and the concept of the Constitution as a “living document” (New York State Standards, n.d.).
4. Generate a set of intended outcomes or objectives for your unit, and specify essential questions. For instance, New York State considers the following to be essential questions for seventh and eighth graders engaged in the U.S. Constitution unit:



**Figure 8.3: Concept map of the U.S. Constitution.**

Why was the Constitution necessary? How does it embody the principles of the Declaration of Independence? How do federalism and the separation of powers promote the ideals within the Constitution and its various amendments? (New York State Standards, n.d.).

Specific outcomes that show how students understand the unit's content and can exercise their thinking include the ability to:

- *Define and explain* all major articles, the separation of powers, and similar concepts
- *Explain* reasons for the development of the Constitution
- *Compare* democracy with a republic/parliamentary system
- *Compare* our constitution with that of another country
- *Develop* a new constitution for your class/school/state and/or a fictitious country and be able to *compare/contrast* similarities and differences and *draw reasonable conclusions*

Having essential questions is splendid, but without specifically identifying what they expect students to be able to know and to do, teachers might not be able to determine the extent and quality of student understanding. These outcomes need to demand that students engage in the 21st century skills of questioning, problem solving, critical/creative thinking, hypothesizing, and reflecting. Note the emphasis on complex thinking with such phrases as “explain reasons,” “compare,” and “draw conclusions.”

5. Design a problematic scenario that will spark students' interests and provide a structure for the entire unit. When creating such a scenario, teachers must incorporate knowledge and understanding of the essential concepts of the unit (in this case the U.S. Constitution) into the intended outcomes.

Here is one possible scenario:

You are a member of a delegation representing a new country in [name the geographical area]. You

need to create your own constitution, but not copy the U.S. model. The constitutional committee of your home country wishes for you to present an explanation of the U.S. model, along with a critique and suggestions for modifications and improvements for your own country. You are not bound by the structure of the U.S. Constitution, but you need to demonstrate an understanding of key concepts such as federalism, balance/separation of powers, decision making, rights of states and citizens, and amendment powers. Furthermore, in your presentation to the constitutional committee in your home country you will need to justify the modifications and improvements you propose.

This scenario is designed to challenge students to not only learn as much as possible about the U.S. Constitution, but also to apply this new knowledge to crafting their own constitution. Of course, to do this properly they will need to know a good deal about U.S. history. Therefore, teachers could modify the scenario by challenging students to serve on a constitutional amendment committee charged with analyzing this “living document”—our U.S. Constitution—and make recommendations for altering it.

6. Formulate strategies that include inquiry approaches like KWHLAQ for observing artifacts and generating good questions. Students can help organize these questions in accordance with their needs, priorities, and ability level. In PBL, students conduct research and critically examine their findings for reliability, bias, verifiable assumptions, and so on. Then teachers collaborate with students on how to share the findings.
7. Use the problematic scenario as a summative assessment. There are many different ways for students to share what they know and understand about constitutions. They can engage in presentations as Cheryl’s students did; share their ideas before a group of citizens; create videos and PowerPoints; engage in debates; write creatively; and, of course, reflect on their progress.

During the unit, the teacher should assess the quality of students' understandings using short-answer quizzes; essays; brief reports on research; and most importantly, writings in their inquiry journals. These journals will contain students' initial questions; research; subsequent questions; and daily, weekly, and/or final reflections on the important ideas they have learned, the process of inquiry, the application of ideas to other subjects, any new questions they have, and how these ideas correspond to their own lives.

### How Do We Enhance PBL With 21st Century Technology?

We can enhance the problematic scenarios by using a wide array of 21st century technologies. Moreover, having students create their own

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connections among a variety of international points of view serves to enhance the significance of content as well as their understanding of what it means to live, survive, and prosper in a globalized world. Consider these examples:

- Daniel, the teacher of a Rosewood Elementary second-grade class in Rock-Hill, South Carolina, used a Promethean ActivBoard to help students understand concepts such as *climate* and *climate change*. The result was, in his own words, “a deluge of questions.” As students became involved with the topic, Daniel was not only able to show Internet images of cold and warm fronts, but could also display several pages of a book he had previously scanned of polar ice floes (personal communication, January 15, 2009).
- Fifth-grade students in Charlotte, North Carolina, were planning their research questions for a final exhibit in an International Baccalaureate school. As they generated questions, the teacher was able not only to record them on the Promethean ActivBoard but also to save their jottings and discussions on their topics as well (personal communication, March 30, 2009).
- Middle school students in Van Nuys, California, and Winnipeg, Manitoba, Canada, communicated with each other across

more than 1,500 miles “almost daily through blogs, wikis, Skype, instant messaging and other tools to share ideas about literature and current events” (Richardson, 2008, p. 37).

- Students in Webster, New York, used web-based social networking tools (blogs, wikis, Skype, and other tools) to “create their own networks” as they investigated the health of local streams around their schools (Richardson, 2008, p. 37). Through their efforts they learned about “global collaboration and communication,” key elements for survival in the highly interdependent and competitive world of the 21st century (p. 37).
- At High Tech High in San Diego, California, students engaged in multidisciplinary projects that allowed them to communicate with experts within the community. For example, students in art, media, and biology came together to produce DVDs to solve problems on blood-related health issues. In a humanities, chemistry, and mathematics collaboration, students researched “African political struggles caused by a scarcity of natural resources,” created documentary films, and modeled water-purification plants, which they then exhibited “before peers, teachers, parents and members of the community” (Rubenstein, 2008, p. 44).

### **What Do We Know About the Effectiveness of PBL?**

Some researchers caution that we need to strengthen the conceptual foundations of PBL research (Belland, French, & Ertmer, 2009). There are others who tell us that challenging students to think through problematic situations can be “superior when it comes to long-term retention, skill development and satisfaction of students and teachers” (Strobel & van Barneveld, 2009, p. 44).

In terms of the efficacy of inquiry, however, we hear stronger support. A 2009 study concluded that “developmental research confirms the idea that curiosity drives intellectual development. . . . When a situation is designed to arouse curiosity, children display improved academic performance” (Engel & Randall, 2009, p. 184). Other studies indicate that when all students are challenged to “organize, synthesize, and explain” a complex problem or issue using

the methods of inquiry and research, there is a positive impact on learning (Newmann & Associates, 1996, p. 29).

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“Developmental research confirms the idea that curiosity drives intellectual development.” (Engel & Randall, 2009, p. 184)

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Other evidence of efficacy comes directly from teachers who have used these kinds of problematic scenarios with an emphasis on inquiry. Teacher Kim Nordin, for instance, tells us that this structure gave her students “focus, drive and excitement . . . allowing them to be inquirers . . . [who] felt like they had ownership of their projects” (personal communication, January 15, 2009). Suzy O’Hara, the International Baccalaureate coordinator, notes that the use of PBL “has provided our teachers with authentic and engaging ways to promote students’ information gathering. It serves as the bridge connecting basic skills, with [the] problem solving and creative thinking needed to be successful in our ever changing world” (personal communication, July 16, 2009).

Enthusiasm for PBL is not limited to the lower grades. Ed Jernigan, the director of the Centre for Knowledge Integration at the University of Waterloo, Ontario, was focused on students solving authentic problems when he said:

We have built our first-year curriculum around a sequence of real-world design challenges asking students to solve meaningful, open problems of societal and environmental concern. Their level of engagement and retention as assessed by case studies, their actual design presentations and their in-depth reflections is unique in my thirty-three years experience at Waterloo. (personal communication, July 20, 2009)

Obviously, more time and study of this real-world approach to teaching and learning is needed to provide deeper insight into its efficacy. As teachers develop expertise with PBL, however, I expect that the formal and informal results will give not only a clearer picture of its impact, but a positive one as well, showing that within such programs we liberate students’ curiosity and imaginations to think boldly, innovate, and implement solutions to 21st century problems.

## Final Thoughts

At this writing, the United States is struggling through the aftermath of the worst economic crisis since the Great Depression. With a warming planet, it is also striving to reach energy independence. Within this context, President Barack Obama laid out an educational challenge:

I'm calling on our nation's governors and state education chiefs to develop standards and assessments that don't simply measure whether students can fill in a bubble on a test, but whether they possess 21st century skills like problem solving and critical thinking and entrepreneurship and creativity. (as cited in Henderson, 2009, p. 4)

To meet these intense and immediate challenges, we need educators like Kerry Faber in Edmonton, Alberta, Canada, whose sixth-grade students realize the importance of asking good questions to solve authentic problems. Some eagerly said, "When I ask good questions, I learn more. . . . Your mind will get stronger, sharper and prepare you for the real world. . . . You start thinking critically. . . . If you ask better questions, you get people thinking" (personal communication, March 15, 2009).

Our challenge in this new century is to help our students build upon their intrinsic curiosities about nature and our living, working, playing, creating and surviving therein. Posing and pursuing substantive questions is what we should all be doing, in schools and as good citizens of this republic. When asked what he and others had wrought at the Constitutional Convention in Philadelphia in 1787, Ben Franklin replied, "A republic. If you can keep it" (as cited in Platt, 1992).

To keep our republic, we need to educate for thoughtful engagement with all of its many challenges.

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