



An Inquiry Process

WORKING DEFINITION OF PBL

PBL (problem-based learning) can be defined as an inquiry process that resolves questions, curiosities, doubts, and uncertainties about complex phenomena in life. A problem is any doubt, difficulty, or uncertainty that invites or needs some kind of resolution. Student inquiry is very much an integral part of PBL and problem resolution.

Thus, in this book, PBL is presented as a way of challenging students to become deeply involved in a quest for knowledge—a search for answers to their own questions, not just answers to questions posed by a textbook or a teacher. Identifying problematic situations within the curriculum, posing questions, researching, and reporting depend on and foster a community of inquiry. In such a community, participants feel free to pose tough questions, learn from and build upon each other's questions, are open to different points of view, listen to and respect each other's ideas, and can work collaboratively toward reasonable conclusions.

IMPORTANCE OF PBL

Imagine life as problem-free. Wouldn't that be wonderful!

Or, would it?

In any case, life does not come problem-free because that is the nature of our life here on earth, full of challenging opportunities to learn, grow, reflect, and enjoy. This may be the most obvious reason why problem-based learning is important for us to consider—PBL engages students in life as we know it, full of fascinating problematic situations worth thinking about, investigating, and resolving.

Stop and Think



Why do you think PBL is so important in today's educational settings?





PREPARATION

The following are some research-based reasons for the importance of PBL:

- Processing information at higher levels, such as with problem solving, critical thinking, inquiry strategies, and reflection on practice, leads to deeper understanding (Perkins, 1992), self-direction (McCombs, 1991), and enhanced retention and transferability of information and concepts (Bransford, Brown, & Cocking, 2000; Marzano, 2003; Marzano, Pickering, & Pollock, 2001; Mayer, 1989)
- Authentic pedagogy—involving knowledge construction, disciplined inquiry, and connections beyond school—results in higher student achievement, regardless of race, class, gender, or SES (Newmann & Associates, 1996).
- Teaching for understanding requires complex intellectual processes such as those involved in PBL—the need to analyze and process information and draw reasonable conclusions (Barell, 1995, 2003; Perkins, 1992). “Learning with understanding is more likely to promote transfer than simply memorizing information from a text or a lecture” (Bransford et al., 2000, p. 236).
- Several intellectual and pedagogical processes normally involved in PBL—including comparing/contrasting, summarizing, nonlinguistic representations, cooperative learning, generating and testing hypotheses, and questioning—have been shown to positively affect student achievement (Marzano et al., 2001).
- High levels of intellectual challenge and social interaction can be very motivating for many students (informal observations).
- PBL is inquiry- and choice-driven. These will be motivational elements for most students, opportunities to think and make choices with peers.
- “Expertise requires well-organized knowledge of concepts, principles, and procedures of inquiry,” the latter playing a significant role in all forms of PBL (Bransford et al., 2000).
- “Learning requires multiple exposure to and complex interactions with knowledge.” During a PBL unit students engage knowledge, skills and attitudes in many and varied contexts, rather than sitting and listening to information (Marzano, 2003).
- Informal observation indicates that some students with learning difficulties (or students who find the traditional classroom routines constraining) are challenged toward more lively and alternative engagements with and responses to content when they have opportunities to make some decisions about what and how to learn on their own.
- Inquiry-as-a-thread can be a way of integrating all instructional and curricular processes (as can cooperative learning and the use of fundamental concepts).
- The world of work requires the very intellectual skills fostered by PBL: problem solving, decision making, creative thinking, visualizing, critical reasoning, and knowing how to learn (SCANS, 1991).
- In controlled experiments, students in PBL classes showed a significant increase in the use of problem-solving strategies and these students gained as much, sometimes more, factual content than students in more traditional classrooms (Stepien, Gallagher, & Workman, 1992).
- Intriguing research from the medical community suggests PBL directly and positively affects the transfer and integration of concepts into clinical problems (Norman, 1992); and in certain PBL classrooms, one

study found an increased use of hypothesis-driven reasoning and greater coherence in students' explanations (Hmelo, 1994).

Stop and Think



Can you think of other reasons for trying PBL? How do the above research findings highlight what you see occurring in classrooms today?

In focusing upon complex, authentic problematic situations PBL affords us an opportunity to examine such experiences from multiple perspectives. Thus, PBL can be more interdisciplinary than pursuing questions within only one subject area.

Perhaps these findings also lead us to examine our classrooms for the extent of reasoning (Goodlad, 1984) and/or the opportunities for transfer of ideas to novel or real-life situations (Bransford et al., 2000; Mayer, 1989). Such research can provide reasons for observing what does occur in classrooms in terms of students' not only receiving information but also, and more importantly, processing (e.g., analyzing) and applying it. What PBL does in all its forms is to provide students with challenges—to encounter a complex situation, to engage in analysis, information gathering, critical thinking about findings and drawing reasonable conclusions.

Another reason for fostering PBL with an inquiry approach is what state and subject matter standards demand. We'll refer to this more in subsequent chapters, but let me cite a goal from the New York State Regents, the group responsible for New York state's educational policy:

Goal 2: Each student will be able to apply methods of inquiry and knowledge learned through all major disciplines and use the methods and knowledge in interdisciplinary applications.

Finally, it goes without saying that at the commencement of the twenty-first century, the problems we face in foreign and domestic affairs, the effects of globalization, and the changes in nature, that we must educate students to be able to identify important problems, ask probing questions, and conduct rigorous investigations aimed at finding answers and solutions. If we fail to educate for inquiry, problem solving, critical/creative thinking, and reflection, our ways of life will surely be in peril. It is our duty as citizens of this republic to become well-informed inquirers and seekers after reasonable solutions to the problems that affect our quality of life here and around the globe.

ELEMENTS OF PBL

Within any PBL unit you are likely to encounter the following elements:

Problem Statement—often in scenario form: “You are a paleontologist (or city planner) responsible for . . .”



PREPARATION

Various roles to be assumed by students

Opportunities to analyze situation, raise questions

Investigations—often within collaborative groups—to search for answers

Critical analysis of findings and drawing of reasonable conclusions

Findings to share, presentations often in front of peers or interested/informed audiences

Various kinds of assessments—informal and formal, authentic, by students and teachers

These elements will, of course, vary by students' ages and abilities, but each PBL has as its core a problematic situation to be addressed.

PBL STRATEGIES

PBL crosses a broad spectrum of instructional patterns, from total teacher control to more emphasis on self-directed student inquiry. Patterns of power and control over decision making are affected by what Fullan (1993) calls “reculturing” the school. That is, if teachers alter patterns of who makes what kinds of instructional decisions, when and how within the classroom, teachers affect the deep structure of the school. PBL can be defined as change in curriculum that can significantly affect the culture of the entire school.

The two major strategies to foster problem posing and inquiry are derived from prereading strategies and good scientific observation processes. The first is KWHLAQ:

- K** What do we think we already **Know** about the subject?
- W** What do we **Want/Need** to find out about it?
- H** **How** and where will we search for answers? How will we organize our investigations (e.g., Time, Access to Resources, and Reporting)?
- L** What do we expect to **Learn**? What have we **Learned**?
- A** How will we **Apply** what we have learned to other subjects? To our personal lives? To our next projects?
- Q** What new **Questions** do we have following our inquiry?

This strategy derives from the K-W-L (Olge, 1986), a prereading strategy designed to engage students in thinking about prior knowledge and the purposes for reading. An earlier version of the KWHLAQ (Barell, 1995) sought to expand this limited application to longer-term curricular units of instruction.

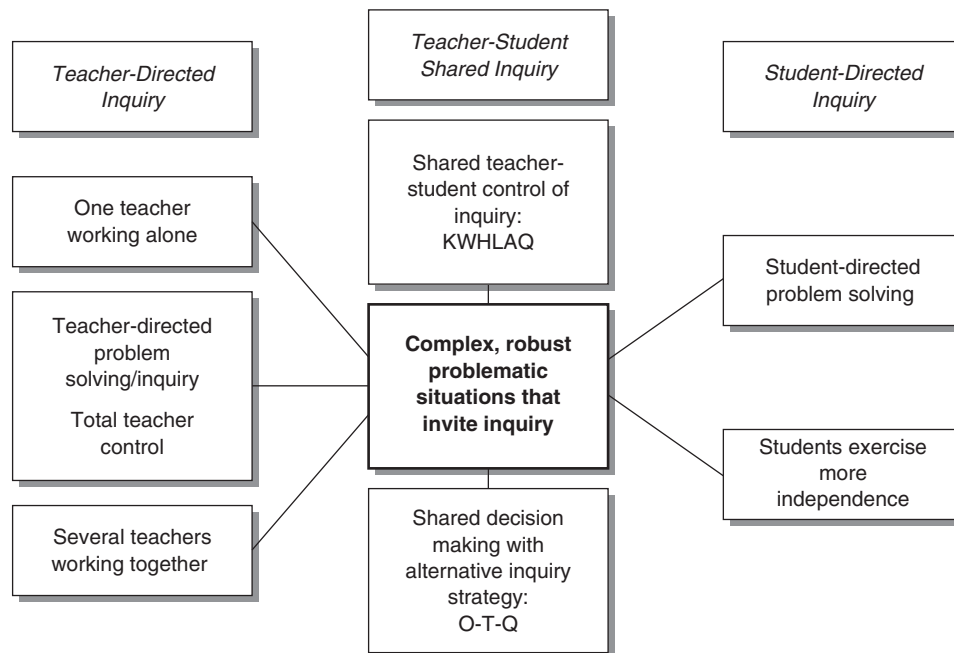
The second major strategy is O-T-Q:

- O Observe** objectively
- T Think** reflectively
- Q Question** frequently

O-T-Q derives from research (Barell, 1992) on inquiry with third graders. When asked to generate questions about recent visits to museums, Disney World, or historical sites, most students had real difficulties forming questions. What helped was drawn from what scientists do: First observe and gather information, then analyze and relate the information to what they know, and finally generate questions.

Figure 1.1 is a display of these strategies within the spectrum of teacher control. The KWHLAQ and O-T-Q are squarely in between total teacher power over decisions and student-controlled decision making. This placement is for illustration purposes only. Obviously, teachers can use either strategy at either end of the spectrum and often do.

Figure 1.1 Problem-Based Learning Spectrum of Strategies



EXAMPLES OF PBL EXPERIENCES

Several teachers already challenge their students with various kinds of PBL experiences, most of which involve inquiry of some sort. Here is a brief description of some of their inquiry projects:



- Kindergartners with some learning difficulties posing questions to figure out what the water cycle is and determining how to explain it to an NBC executive searching for a “weather person.” (Newark, NJ)
- Third graders posing questions about why sun flares “fall out into space,” why school buses are painted yellow, how people dressed thousands of years ago, and why there are no women presidents (yet!)? (Peg Murray, Bradford Elementary School, Upper Montclair, NJ)
- Fifth graders investigating what life was like during World War II from survivors in the local community (Robin Cayce, Chattanooga, TN)
- Middle school students with learning difficulties want to figure out what law enforcement, education, and emergency services are needed for a new business relocating to your town (Ashland, WI)
- High school students in Spanish class have to figure out how to welcome the growing population of immigrants to their home town (St. Croix Falls, WI)
- Tenth-grade biology students hypothesizing about the extent of bacteria within the school, conducting research, analyzing findings, and reporting (Vin Frick, Dumont High School, Dumont, NJ)
- Twelfth graders in political science class respond to their own question, “If I want to become president of the United States, how do I go about getting elected?” Their research consists of selecting candidates, holding caucuses, and running for election (Ed Bertolini, Jefferson Township High School, Oakridge, NJ)
- Twelfth-grade Chemistry students must determine whether or not to approve the construction of a nuclear power plant for their community (LoriAnn Davide, James Caldwell High School, Caldwell, NJ)

Most of these experiences can fit within one or more of the elements of the PBL Spectrum of Strategies (see Figure 1.1). Some reflect different phases of the spectrum of control (the horizontal axis), from complete teacher control on the left to more student self-directed learning on the right.

How often PBL can be used involves such considerations as time, resources, ability and maturity of students, school culture and climate for inquiry and research, basic beliefs in the nature of teaching and learning, and the amount of commitment to these principles.

Each reflects the presence of a significant problematic situation worth investigating. What do you notice about each of these problematic situations? What characteristics do they have in common? Here are some I’m sure you have noticed:

Complex: They have no easy, obvious answers found within a book and invite interdisciplinary investigations from multiple perspectives.

Fascinating: They are fun to investigate, often with teams of students.

Meaningful: They relate to our major curricular objectives as well as to our own lives.

Authentic: They often come from life as we know it.



Problem-based learning allows us an opportunity to conduct investigations that are also

Inquiry- and choice-driven, each requiring decisions about what is important, what we need to know, and how we will find answers

Team/group organized, allowing for collaboration at all stages

Intellectually challenging, requiring problem solving and critical analysis in order to figure out answers/solutions

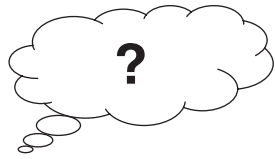
Conclusive, each able to lead us to making judgments based on well-researched evidence

When curriculum is arranged and focused upon such intriguing problematic situations, we will notice something different happening—students of very different abilities and interests will become involved in ways we haven't observed before. Students with learning difficulties and those with previously low achievement records might become far more interested and involved because we are presenting them with opportunities to make choices, take more ownership of their own learning, and to express themselves in different fashions.

On the other hand, we may also find that our previously high achievers have some difficulty with this format because it does not involve “Guess what's on the teacher's mind and what's going to be on the test.” PBL presents them with challenges quite different from memorizing content presented by the teacher. It is far more challenging and breaks routines and boundaries previously held sacred within the classroom.

Jack Welch, previously CEO of General Electric, transformed this company with a concept called “boundaryless,” meaning he broke down traditional lines of authority among leaders, managers, and employees in order to get the best minds working on complex problems. In a way, PBL represents this kind of “boundarylessness” in our classrooms (Welch, 2001, p. 186).

PBL of this nature requires that we establish a classroom environment that welcomes questioning and different points of view and that thrives on collaboration among all participants.



What's My Thinking Now

Reflection

Comments

Questions