An Introduction to Problem-Based Learning

The following information can be found at the Samford University’s Center for Problem-based Learning Web Site at http://www.samford.edu/pbl/

Sir Wilfrid Laurier School Board
I. Problem-Based Learning -- Background

1.1 Origins

Problem-based learning (PBL) as a teaching strategy and curricular design began over thirty years ago at McMaster University in Canada. Using problems based on actual clinical cases as focal points in a medical program evolved after years of medical faculty and student frustration with the traditional lectures and challenging clinical experiences. Imparting and absorbing the immense amount of content inherent in a medical education was becoming more unrealistic and improbable. Drawing from the tutorial process developed by Barrows (Barrows & Tamblyn, 1980), the medical curriculum shifted from a faculty-centered approach to a student-centered, interdisciplinary process.

Hybridization of the McMaster PBL approach has occurred at numerous institutions. Harvard Medical School derived its use of PBL from earlier work at Case Western Reserve University (Boud & Feletti, 1997). At the latter institution, faculty at the school of medicine employed an interdisciplinary lab and a variety of teaching strategies to educate students. Harvard expanded upon these experiences by integrating PBL problems with didactic, discussion and experiential sessions (Tosteson, Adelstein & Carver, 1994).

The continued use of PBL arises from the recognition that students retain minimal information obtained from traditional didactic teaching (Bok, 1989) and have difficulty transferring knowledge to new experiences (Schmidt, 1983). According to Schmidt, PBL provides an environment in which students can draw upon prior knowledge, learn within the real-world context, and reinforce the knowledge through independent and small group work.

1.2 Definitions

There are numerous definitions and interpretations of PBL. Some faculty and institutions ascribe to the original definition which is:

PBL is both a curriculum and a process. The curriculum consists of carefully selected and designed problems that demand from the learner acquisition of critical knowledge, problem
solving proficiency, self-directed learning strategies, and team participation skills. The process replicates the commonly used systemic approach to resolving problems or meeting challenges that are encountered in life and career (Barrows & Kelson, year)

Other definitions abound. A key point to designing, implementing and assessing the student outcomes achievable with PBL is to determine the definition that best fits your teaching philosophy and your institution’s mission. Some of the PBL definitions generated include:

PBL is an approach to structuring the curriculum which involves confronting students with problems from practice which provides a stimulus for learning (Boud & Feletti, 1991).

Problem-based learning (PBL) is an instructional method that challenges students to "learn to learn," working cooperatively in groups to seek solutions to real world problems. These problems are used to engage students' curiosity and initiate learning the subject matter. PBL prepares students to think critically and analytically, and to find and use appropriate learning resources (Duch, 1995).

Problem-based learning is a development and instructional approach built around an ill-structured problem which is messy and complex in nature; requires inquiry, information-gathering, and reflection; is changing and tentative; and has no simple, fixed, formulaic, “right” solution (Finkle & Torp, 1995).

Problem-Based Learning (PBL) is an instructional strategy that promotes active learning. PBL can be used as a framework for modules, courses, programs, or curricula (Samford, 1998).

1.3 Characteristics of A Problem-based Activity

- Ill-structured, complex problems provide the focal point(s) and stimuli for the course, curriculum and/or program.
- Learning is student-centered.
- Teacher acts as a coach or facilitator.
- Students work in small groups to solve/provide multiple solutions to problems.
- Learner assessment is enhanced by self and peer assessment.
1.4 Aims

According to Barrows and Tamblyn (1980) and Engel (1997), PBL can, regardless of discipline, enhance students’ achievement of:

- Adaptation and participation in change
- Application of problem solving in new and future situations
- Creative and critical thought
- Adoption of holistic approach to problems and situations
- Appreciation of diverse viewpoints
- Successful team collaboration
- Identification of learning weaknesses and strengths
- Promotion of self-directed learning
- Effective communication skills
- Augmentation of knowledge base
- Leadership skills
- Utilization of relevant and varied resources

1.5 Comparison with other Teaching Strategies

The Illinois Mathematics and Science Academy (1996) compared prescriptive and experiential curriculums. Using these as endpoints on a continuum, one would place PBL close to the latter. Again, depending on one’s interpretation and usage of PBL, this can vary.

<table>
<thead>
<tr>
<th>Prescriptive Curriculum</th>
<th>Experiential Curriculum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teacher-centered</td>
<td>Student-centered</td>
</tr>
<tr>
<td>Linear &amp; rational</td>
<td>Coherent &amp; relevant</td>
</tr>
<tr>
<td>Part to whole organization</td>
<td>Whole to part organization</td>
</tr>
<tr>
<td>Teaching as transmitting</td>
<td>Teaching as facilitating</td>
</tr>
<tr>
<td>Learning as receiving</td>
<td>Learning as constructing</td>
</tr>
<tr>
<td>Structured environment</td>
<td>Flexible environment</td>
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</tbody>
</table>
Savin-Badin (2000) delved into the differences between PBL and other teaching strategies. Drawing upon Barrow’s work, she delineated the basics associated with each of the following strategies:

<table>
<thead>
<tr>
<th>Teaching Strategy</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>Lecture</td>
<td>Information presented and discussed by faculty instructor.</td>
</tr>
<tr>
<td>Case-based</td>
<td>Written case histories provided prior to lecture and followed with in-class discussion about content and concepts.</td>
</tr>
<tr>
<td>Case method</td>
<td>Written case histories provided prior to class, studied and then discussed in class (typically in small groups)</td>
</tr>
<tr>
<td>Modified case</td>
<td>Incomplete, written information provided and studied prior to class. Within groups, determination made as to additional information needed. Sometimes additional information provided in class.</td>
</tr>
<tr>
<td>method</td>
<td></td>
</tr>
<tr>
<td>Problem-focused</td>
<td>Students provided with a simulated problem/scenario.</td>
</tr>
<tr>
<td>Problem-based</td>
<td>Incomplete, written information provided and studied prior to class. Focus is on identifying learning issues applicable to resolution of the problem. Content and concepts relevant to learning a key component.</td>
</tr>
</tbody>
</table>

The differences between case-based and problem-based learning can be difficult to ascertain. In a study examining both expert and non-expert tutors, Hay and Katsikitis (2001) determined the two are similar. The uniqueness of each is in the presentation of the problem. With case-based, the problem is accompanied by resource materials and questions; with PBL, only the problem is provided. PBL focuses more on what students do, rather than what teachers do (MacDonald & Issacs, 2001).
II. Problem-based Learning Process

2.1 Overview

In most courses, students are bombarded with enormous amounts of material to read and display their comprehension by completing related problems. These problems typically have required a neat, pat answer. This method does not prepare our students for professional problem resolution.

Problem-based learning (PBL) begins with students, working in small groups, delving into, determining key issues, and then solving a “real-world” problem under the guidance of a facilitator. By focusing upon a realistic problem, students develop a varied and deeper perspective and knowledge of the subject area. This process is not a new one; indeed, it has its beginnings in the ancient apprenticeship model which is learning by doing.

According to James & Baldwin (1997), PBL alters traditional teaching and learning patterns. This process of presenting a topic piece by piece until students assimilate the various pieces of knowledge and hopefully apply them to personal and professional problems has not been shown to be effective. PBL allows students to explore relevant sources of knowledge. PBL encourages students to take charge of their own learning.

In comparing PBL with other teaching strategies and determine the best method for achieve desired student outcomes, one might view the graph below:
2.2 Curriculum Mapping

A curriculum is an academic plan or strategy in which the total blueprint for action is outlined. Within this blueprint, there are broad and specific objectives, aims and outcomes stated. The processes by which to achieve and assess these objectives are also described (Khoo, 2001). The main purpose behind formulating a curriculum is to foster the academic and personal development of a specific group of students.

PBL can be a portion of the curricular instruction process, the entire focus or a curriculum or only within a course, unit or module. Frequently, resources (i.e. personnel, financial) and facilities place constraints on the breadth and depth of PBL use.

Initiating PBL within a curriculum can create anxiety for administrators, faculty and students. Anxiety comes from change and uncertainty as to efficacy of PBL. Anticipate this and meet it with:

- Explanations regarding the use of PBL and provide to all relevant constituents of the curriculum.
- Provisions for teacher development
- Orientations to the students

Once the decision is made to use PBL within/to guide a curriculum, consider centralizing the curriculum management of PBL. Determine who has the power and authority for designing, implementing and evaluating PBL. Explore the essential content. This is relevant to the success of PBL as you will not have sufficient time to cover all content in depth – pare down to the absolute “need to know.”

In your endeavor to use PBL within your curriculum, be aware that PBL can take more time than traditional teaching strategies, like lectures.
In choosing the problem title and introductory information, consider if the problem is . . .

<table>
<thead>
<tr>
<th>Interdisciplinary</th>
<th>Original</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current</td>
<td>Product/Goal/Skill oriented</td>
</tr>
<tr>
<td>Open-ended</td>
<td>Probing</td>
</tr>
<tr>
<td>Complex</td>
<td>Relevant</td>
</tr>
</tbody>
</table>

**Compare & Contrast Problem Structures**

**Well-structured**
- What are the roles of a nurse in critical care?
- What are the start-up costs for a daycare?

**Ill-structured**
- Euthanasia: Allowing dignity or committing a
- As the supervisor, you have noticed there has been a significant amount of absences in the women who work in your department.

**Evaluating Your Problem**

**Sample rubic: Formulation of design problem (Univ. of Delaware, 2001)**

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Excellent</th>
<th>Good</th>
<th>Needs Improvement</th>
<th>Not Acceptable</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Formulation &amp; Scope of Problem</strong></td>
<td>Clear, well thought out; scope well-defined.</td>
<td>Formulation clear, but scope not well-defined.</td>
<td>Formulation somewhat unclear, not well thought out.</td>
<td>Problem not formulated clearly.</td>
</tr>
<tr>
<td><strong>Significance</strong></td>
<td>Problem represents current challenge; large potential market.</td>
<td>Problem represents current challenge, but small, vaguely defined market.</td>
<td>Problem not a current challenge; market small or not well defined.</td>
<td>Problem not a current challenge; market analysis.</td>
</tr>
</tbody>
</table>
Approaching the Problem(s)

Using a modification of a process developed by the Department of Medical Education at the Southern Illinois University School of Medicine, your students can be introduced and solve a PBL problem. The process involves:

1. Introducing the concept and rationale for use of a PBL problem within the course/module/unit.

2. Setting the stage.
   a. Roles and responsibilities of the various group members. In PBL, the recommended group size is from 4 to 6 students. Each student can take (and hopefully rotate) the role of leader/encourager, reporter/skeptic, animator/presenter and recorderscribe.
   b. Rules of Trust. An example of this can be found below.
Rules of Trust

Instructions: Discuss and write down the group’s rules of trust. An example of a rule might be “Be on time,” or “Comes prepared with copies of materials for all group members.” Delineate possible consequences for rules that are broken. The course instructor reserves the right to review and approve the rules and consequences stated below. Once this sheet is completed, each member of the group should sign thus signifying agreement with the rules. Write their name in the space provided.

Rules & Consequences:
1. 
2. 
3. 
4. 
5. 

Group Members:
1. 
2. 
3. 
4. 
5. 

3. Encountering and working on the problem.

Hypotheses  Information  Learning Issues  Action Plan  Evaluation

Brainstorming  What data do you have?  List of what is needed to acquire additional data and complete the problem.  Activities needed to be done in order solved? Does the process need to be repeated?

4. Self-directed study

5. Problem follow-Up
   a. Resources identified and evaluated
   b. Summary of problem
   c. Reassessment of problem
6. Group evaluation

7. Knowledge abstraction and summary
   a. Definitions, concepts, abstractions & principles outlined
   b. Diagrams, lists, concept maps, flow charts generated

8. Self and peer assessment

9. Facilitator assessment

### 2.4 Group Process

There is sufficient evidence in the literature that most students learn better when they are collaborating, providing and receiving information, supporting and encouraging, resolving conflicts and communicating with others. Group work, then, can enhance student learning. Placing students in groups and expecting nature to take its course will not work. Group members require the knowledge and skills to work their way through the group process. Without such information, a situation such as this can occur:

A team of students had four members called Everybody, Somebody, Anybody and Nobody. There was an important job to be done. Everybody was sure that Somebody would do it. Anybody could have done it, but Nobody did it. Somebody got angry about that because it was Everybody’s job. Everybody thought Anybody could do it but Nobody realized that Everybody wouldn’t do it. It ended up that Everybody blamed Somebody when Nobody did what Anybody could have done (Gibbs, 1995).

The criteria for successful group work, according to Meyers and Jones (1993), requires the group activity to:

- Allow a sense of interdependence among the group members
- Encourage individual student’s accountability to the other group members and the instructor
• Provide frequent face-to-face interaction for promotion of team goals
• Allow for the development of social skills needs for collaboration
• Complete the cycle with critical analysis of the group process

2.5 Roles & Responsibilities

Facilitator Role

The facilitator role allows the faculty member or student mentor to act as a/an:

• Content and procedural resource person
• Facilitator of group processes
• Guide to additional resources
• Sounding-board person
• Learner

Issues for teachers in delving into PBL, particularly in the learning stages, is the amount of time needed to prepare course materials, develop problems, train other facilitators and determine authentic assessment of student work. The other critical issue is the role reversal. Instead of being the “sage on the stage,” the faculty member is now to be the “guide on the side.” Instead of lectures, the faculty member now models various methods of problem-solving, sometimes referred to as “cognitive apprenticeship” learning (Brown, Collins & Newman, 1989). Meta-cognitive questions such as “How do you know that?” “What assumptions might you be making?” and “What else might you need to know?” are used by faculty versus dictating how to solve a problem.

Student Role

The student role is altered with PBL. PBL contrasts considerably with the traditional teaching most students have encountered. Students have difficulty with the concept and use of self-directed learning (Schmidt, Henny & de Vries, 1992). Be aware that students may react to the idea of PBL with shock, denial, anger, resistance, acceptance and finally, confidence.
Students also must take responsibility for their own learning. PBL encourages students to identify their learning needs and determine the resources they will need to use to accomplish their learning. With the independent learning comes considerable collaboration with other students and faculty. Collaborative work among students facilitates their comprehension of the problem and the application to future situations. Collaboration is an essential skill for students to gain as they will most likely be working as members of teams in their respective workplaces.

Two often difficult tasks that students encounter in PBL is the process of reflection and peer assessment. Reflection, or self-assessment, allows the student to complete the learning cycle. What did I learn? What more do I need to know? How can I approach this problem in the future? And so forth are key questions we want students to ask of themselves. Students must become proficient in not only assessing their own progression in learning, but that of their peers as well. The ability to monitor one’s own learning as well as providing credible feedback to one’s colleagues is an important personal and professional skill.

Orienting students to PBL is a must. One approach would be to introduce the concept and rationale for use of PBL in a course (or curriculum). Another would be to have the students work on a sample problem which is followed by a debriefing session.
III. Printed & Electronic Resources

Additional information related to use of PBL in a curriculum or course as well as problem design and implementation can be found in the materials listed below:

Websites

Adelaide University

Belmont University
Problem-Based Learning Workshop; Belmont University, Ronnie Littlejohn, Facilitator
http://www.belmont.edu/Humanities/Philosophy/PBL/Effectiveprob.html

Illinois Mathematics and Science Academy
Model Problems - http://www.imsa.edu/team/cpbl/whatis/model.html
PBL Tutorial - http://www.imsa.edu/team/cpbl/whatis/whatis/slide1.html
Article - Problems as Possibilities:Transforming Garbage to Gold (Sheryl Finkle, Ph.D., and Linda Torp, Ed.S.) http://www.imsa.edu/team/cpbl/whatis/garb/index.html

Itawamba Community College
Problem-Based Learning (PBL) Database http://www.icc.cc.ms.us/academic/PBL/index.html

Maricopa Community Colleges
PBL at Maricopa-Lesson plans http://www.mcli.dist.maricopa.edu/pbl/materials.html
McMaster University


San Diego State University Problem-Based Learning

[http://edweb.sdsu.edu/clrit/learningtree/PBL/WhatisPBL.html](http://edweb.sdsu.edu/clrit/learningtree/PBL/WhatisPBL.html)
Investigating PBL: A WebQuest - [http://edweb.sdsu.edu/clrit/PBL_WebQuest.html](http://edweb.sdsu.edu/clrit/PBL_WebQuest.html)

University of California, Irvine

[http://www.pbl.uci.edu/examples.html](http://www.pbl.uci.edu/examples.html)

University of Delaware

PBL Clearinghouse - [http://www.mis4.udel.edu/Pbl/](http://www.mis4.udel.edu/Pbl/)
Problem Writing Guide by Barbara Duch [http://www.udel.edu/pblc/problems/](http://www.udel.edu/pblc/problems/)

Publications


order thinking skills. *Journal for the Education of the Gifted*, 20 (4), 401-422.


An example of using PBL in a curriculum can be seen at the following websites:


Additional resources you may wish to refer to before or during incorporating PBL into your curriculum include:


