"Problem-based Learning: helping your students gain the most from PBL" 3rd edition, March 1996

Instructor's Guide for "Problem-based Learning: how to gain the most from PBL" ISBN 0-9698725-0-X

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1. Why PBL?

Improving learning and selecting a version of PBL that is suitable for you

Problem-based learning, PBL, is one of the most exciting and powerful educational options that has appeared in the last 30 years.

PBL is a generic term. Forms of PBL that have been used include research, Case Studies, Guided Design, engineering design projects and, more recently, the McMaster Medical School model of PBL.

Research: an individual, perhaps with guidance from a faculty supervisor, diligently gathers data to resolve a dilemma or unknown. The search starts with the dilemma. Find a cure for cancer.

Case Study: a situation or case is posed. The task is to resolve it. Consider the balance sheet of Widget Company. Will the company prosper or go bankrupt?

Guided Design: a case is posed. Small groups worked cooperatively to work through a structured problem solving strategy to decide a course of action. The activities are structured ahead of time. At the end of each activity, the instructor gives feedback to each group before it can proceed with the next activity. Unsuspecting motorists have numerous accidents on bridges because in winter ice often forms on the surface of a bridge before ice forms on the highway. Reduce the number of accidents!

Engineering design project: engineering students are given a product to build or create. Design a plant to produce 20,000 metric tonnes per annum of acetylsalicylic acid (aspirin).

Medical School model: health situation is posed. Harry Blighter, a 23 year old unemployed truck driver, complains of a recent onset of double vision and head aches.

Some forms can be used for large classes, some for small groups and some for intermediate sizes. In the business school Case Study approach to PBL, the class size and dynamics are completely different from the McMaster MD program small group approach. In the former, the tutor is a Socratic facilitator of the problem solving processes used by a group of 60 to 100 to "solve the case." In the latter, the tutor is a facilitating presence used as needed by a group of 5 to 9 to "solve the case." All are PBL.

PBL is powerful because:

PBL is a learning environment that embodies most of the principles that we know improve learning: active, cooperating, getting prompt feedback, tailored to student's learning preference with student empowerment and accountability. Hence, the quality of the student learning should improve especially when compared with the lecture.

PBL forces the students to learn the fundamental principles of the subject in the context of needing it to solve a problem. Hence, the subject knowledge islearned in formats different from those from the traditional subject-based format. We hope (and are yet awaiting irrefutable evidence) that this makes a significant improvement in a student's ability to recall and later use the subject knowledge.

PBL offers an opportunity to practice, use, (and even develop) such processing skills as problem solving, interpersonal, group and team skills, the ability to cope with change, lifetime or self-directed learning skills and self-assessment skills. These are valued skills in themselves. Indeed, this poses a dilemma. Students should have "good" abilities with these processing skills if they are going to be able to gain the most from PBL. To some extent, your success with PBL will depend on the student's processing skills. PBL is about **learning subject knowledge** in the context of using and developing **process skills**. Too often we focus only on the subject knowledge being learned.

Some may be trying PBL for the first time and adapting the principles to apply to their situation. It could be a class of 300, first year biochemistry students. The question is

"What form of PBL might I use and how might the companion text "Problem-based Learning: how to gain the most from PBL" (**HTGTM**) help me and my students?"

Alternatively, some of you may have been using small group, self-directed, tutor-facilitated PBL for a number of years and are looking for additional ideas to help the students gain the most from the experience.

The major challenges to implementing any PBL program are:

1.To remind yourself of the principles of how to improve learning and how to flexibly apply these principles to your situation to develop a form of PBL with which you are comfortable. (If this is a challenge for you, see the rest of this Chapter)

2.To accept your role as **coach/facilitator** as opposed to the familiar **lecturer**. (If this is a challenge for you see Chapter 2.)

3.To resolve how important it is to develop your student's ability with the "processing skills." (If thisis an issue for you, please see Chapter 3.)

4.To put together the key components needed to create the appropriate learning environment. (Chapter 4 addresses this issue.)

5.To decide how to assess. (see Chapter 5.)

Consult whichever issues are important to you. Use the annotated index to help define terminology and select more specific issues.

A companion book "Problem-based learning: resources to gain the most from PBL," (**Resources**) gives practical examples of objectives, assessments and workshops that you can use to introduce PBL and to develop processing skills. This is cross-referenced as **Resources** in this book.

In this first Chapter, we consider the general principles to improve learning, then we see how PBL embodies most of these principles. The principles have been applied through a variety of different classroom settings. How can you sample or nibble or experiment with a small variation? what might you do to enrich? or develop a whole program or extend an existing PBL program? If you elect a small-group, self-directed, PBL format, how can you do this if you have a large class? What are the implications if you cannot provide a tutor for each group? Each issue is considered in turn.

1.1 Principles to improve learning

The general principles are given by Chickering and Gamson (1987 & **HTGTM**, p 4-1 and 4-2) with additions from Ramsden (1982), Novak (1989), Gibbs (undated) and our own research. To improve learning:

1.Students must be actively involved in the learning activities; not passively listening to you and me lecture. [Johnson and Johnson, 1982; Johnson, Johnson and Smith, 1991]

2.Students should work cooperatively together to help each other learn; [Johnson and Johnson, 1982; Johnson, Johnson and Smith, 1991]

3.Provide learning activities that exploits the students unique learning preference. Not all students learn the same way. Each has a preferred style. [Keller, 1968; Grayson and Biedenbach, 1974; and Felder and Silverman, 1988]

4.Students should have clear goals and criteria to tell them when the goals have been achieved. [Mager, 1962; Kibler et al. 1974; and Popham and Baker, 1970]

5.Students should get prompt feedback about their performance. It is not that useful to give them back a marked report three weeks after it was completed.

6.Empower the students to have some role in the assessment. (Whether it is peer or self-assessment.) [Gibbs, undated; Novak, 1989; and Brown and Pendleberry, 1992]

7.Provide a work environment that **expects** that they will succeed. Learn and use their names; take a personal interest in each student. (As opposed to one where you communicate that your role is to "weed them out," "cover material," "satisfy tough

standards," "do my thing without getting personally involved with you the students," or "do my thing because the **real** reason I'm here is to do research.")[Woods, 1985]

8.Provide rich tutor-student interaction through many different types of in-class and outside class events.

9.Don't expect "processing skills" to be developed by providing "opportunities." Asking students to work in groups does not necessarily develop good group skills; asking students to solve problems, does not necessarily develop problem solving skills. [Woods, 1993a-d; Norman and Schmidt, 1993; Resnick, 1987; Meiring, 1980; and Perkins and Salomon, 1989]

Therefore, to improve learning we should:

Create an environment that embodies and uses as many of these principles as we can,

Use our expertise to facilitate the **learning.** Yes, we may have expertise in "lecturing" or delivering information; what about your expertise in "learning"? To me, one of the richest examples of learning is working with my graduate students. Here my student and I pose a problem, and then we work together to try to solve it. The most exciting times for me are when the student is stuck. Then, one-on-one we address the problem and solve it together. What small group, self-directed, PBL is for me, is the creation of an opportunity where I can use those one-on-one skills with a class of 100.

In summary, research has suggested ways to improve student learning. How can we apply this research in the classroom?

1.2 Where PBL fits in

PBL comes in many different forms. Regardless of the form, usually small-group, self-directed PBL embodies most, if not all, of the nine fundamental principles outlined above in Chapter 1.1. PBL can be used in public, high, college and adult learning situations. Jim Anderson pioneered the application of these principles in Hamilton, ON, in a very successful high school for "dropouts" called Cool School. Other high schools in the Hamilton area and in Alberta are using this approach. It can be used apparently in any subject and at most levels. Why not yours?

1.3 What to do in your situation: nibbling, enriching, developing and extending.

You don't have to convert your whole Department, program, or course to PBL. You don't have to use small groups. You can try and experiment with a few ideas: active learning? prompt feedback? pose a problem first and then lecture? Naturally, I have found that using small group, self-directed, interdependent PBL is where I ultimately wanted to be. However, I started in 1970 by learning as much about the McMaster Medical school approach as possible. By 1980, I was implementing in-class workshops for students to develop their processing skills needed in small group, self-directed, self-assessed PBL.

Then, in 1985 I cancelled lectures in a course and tried - with much trepidation - this form of PBL. Since then, my only question has been why didn't I do this sooner.

Hence, start where you are comfortable and with what is consistent with your academic environment. My terminology is:

nibble: first exploration to see what some of the issues might be; to try some aspect related to PBL. (You may be lecturing now to large classes and now want to apply some of these ideas; you might wish to explore what PBL is all about.)

enrich: what you might do if you have already tried some aspect of PBL and want to add more.

develop: how to use small group, self-directed PBL.

extend: for those who have been using small group, self-directed PBL and want to further enrich and extend the experience.

Table 1-1 lists some learning environments and offers suggestions about what you might do. The suggestions are more demanding to implement as we move to the right in this table.

Example:

Dave teaches 80 students Physics. He has heard about PBL and is relatively dissatisfied with the atmosphere and with the quality of the student's learning in his present classroom.

An Answer:

Dave wants to nibble. From Table 1-1, Dave notes that the Osterman Feedback lecture is a gentle change from what he currently does. This requires about 10 h of preparation time in order to try this for a span of 6 lectures. Of the nine principles given in Section 1.1 this introduces activity and cooperation. It also introduces the problem first, even though Dave then continues to "lecture." However, posing the problem first will also lead Dave comfortably toward "tutor-directed modeling."

1.4 More ideas on what to do: big class? small class? tutored or tutorless groups?

The class size and the amount of resources available are, to many instructors, major impediments to moving toward PBL. They need not be. The information in Table 1-1 has been recast in Table 1-2 to consider strictly the size of class. This lists some optional forms of PBL. The OK entries mean that I am aware of programs that are using some form of PBL in that context. Thus, no matter what the situation, we can usually use some form of PBL.

Must there be tutors with each group? The McMaster Medical school model uses a faculty tutor with each group of five. If we want to use PBL in our class and we are starting alone, we may not be able to provide a tutor for each group. We could:

empower the groups to function **without** a tutor, and thus, the student group members learn skills in facilitating the group, task, problem solving and learning process. The tutor's role is one of creating the environment and monitoring, at a distance, key milestone activities of the group.

be a wandering tutor. The tutor wanders among the groups and, upon invitation, become a temporary group member to facilitate the process.

Details about these, and how to address them for both situations, are given by Woods, Duncan-Hewitt, Hall, Eyles and Hrymak (1995).

The processing issues that the groups face if they are tutorless are completely different from those faced by tutored groups.

1.5 Does PBL work? effectiveness of PBL

Yes and "no." The results depend on what and how you test. Consider the easier part first. Do the students respond positively about the learning experience? (student's attitudes and opinions about the course; approaches to studying and learning, environment positive towards learning) Yes. PBL is preferred over the conventional. We define a measure d = the difference between the mean responses from PBL and from the conventional divided by the standard deviation of the mean for the conventional. PBL is preferred by d = +0.5 on all measures. (What about medical student's clinical performance, practical problem solving? Yes; d = +0.3. Vernon and Blake (1993) and Albanese and Mitchell (1993).

How well do the students learn the subject knowledge? On tests that seem to be checking factual recall and factual information, the PBL students perform poorer. To me, this result is what I expect. In the traditional programs, over a fixed time frame, students are asked to "learn subject knowledge" and we test them only on that knowledge. In SG, SDL, SA PBL, over the same fixed time period, we ask students to learn the subject knowledge **and** to acquire lifetime learning skills, problem solving, group skills, self-assessment skills, communication skills. Testing them only on the factual subject knowledge is inappropriate. We need to assess what we believe are the knowledge **and** the skills being developed.

Albanese and Mitchell (1993) suggest that about 20% less subject knowledge can be covered in a PBL course than in a conventional, lecture-based course. That is, 20% of the time is spent with the processing skills.

Furthermore, the PBL students seem to have less confidence that they have acquired as strong a foundation in fundamentals as have students from a conventional program. Students from a PBL program have a different style of approaching problem solving.

Table 1-1 How to nibble, enrich, develop and expand

<table>
<tr><th>Environment</th><th>Nibble</th><th>Enrich</th><th>Develop</th><th>Extend</th></tr>
<tr><td rowspan="3">If you have a large class: >10 students per faculty.</td><td>Continue to lecture but try 3 to 6 lectures as the Osterman Feedback lecture. (see Resources Section A.1 for details)</td><td>Try the MPS-Osterman feedback lecture that gives explicit training in "process skills" (see Resources Section A.2 for details)</td><td rowspan="5">Try Socratic facilitation or tutor-directed modeling of the Problem case process. (see Resources Section A.7 for details) and

Try explicit training workshops for the processing skills (see Resources Chpt. B for details)</td><td rowspan="5">Try self-assessment and explicit development of processing skills (see Resources Chapters B and C for details.)</td></tr>
<tr><td colspan="2">Try cooperative learning. (see Johnson et al. 1991)</td></tr>
<tr><td>Try "Guided Design" for one portion of the course. (see Resources Section A.5 for details)</td><td>Relax some of the structure of Guided Design and allow freedom in selecting Objectives (see Resources Section A.6 for details)</td></tr>
<tr><td rowspan="2">If you have group projects.</td><td>Use feedback forms to develop process skills. (see Resources Section A.3 for details)</td><td>Feedback forms, monitoring and mark for processing skill development (see Resources Section A.4 for details)</td></tr>
<tr><td>Try "Guided Design" (see Resources Section A.5 for details)</td><td>Relax some of the structure of Guided Design and allow freedom in selecting Objectives (see Resources Section A.6 for details)</td></tr>
</table>

If you have a thesis or research or seminar course	Keep individual format but use feedback forms to develop process skills. (see **Resources** Section **A.3** for details)	feedback forms, monitoring and mark for processing skill development (see **Resources** Section **A.4** for details)		
	Put them in groups and try "Guided Design" (see **Resources** Section **A.5** for details)	Relax some of the structure of Guided Design and allow freedom in selecting Objectives (see **Resources** Section **A.6** for details)		

Table 1-2: Matching optional forms for PBL with class size and the pertinent parts of **HTGTM** and **Resources**

PBL options	Class size for 1 instructor					Pertinent parts of **HTGTM**
	<10	<30	<60	<200	<1000	
Pose problem first followed by Osterman Feedback-lecture (see **Resources** Section **A.1**)	OK	OK	OK	OK	OK	Chapters 2 & 3
MPS-Osterman feedback- Lecture (see **Resources** Section **A.2**)	OK	OK	OK	OK		Chapters 2 & 3
PBL pattern in lecture or tutorial; Socratic facilitation of the "process;" eg. business school case (see **Resources** Section **A.7**)	OK	OK	OK			Chapters 2 & 3;
PBL pattern for assessment: Branda's PBEE (see **Resources** Section **F.5**)	OK	OK	OK	OK		Chapters 2, 3, 6, 7, 8 & 9
PBL via Guided Design with written, structured feedback to small groups of 5 (see **Resources** Section **A.5**)	OK	OK	OK	OK		Chapters 1 to 10
PBL via tutor monitoring of "goals" for small groups of 5	OK	OK	OK			

PBL in Medical School model of tutor with each small group.	OK					
PBL and research	usually 1 on 1; maybe team research					

These findings should have a major impact on how we set up our PBL program, what our expectations are and how we assess.

Albanese and Mitchell (1993) should be read by anyone setting up a PBL program.

1.6 Summary

PBL embodies most of the principles of how to improve learning. Different versions of PBL capitalize on and exploit different principles. In one's quest to improve learning, we suggest that you select the principles best adapted to your situation. Ideas are given about how to experiment and implement a version of PBL that suits you.

Two other themes evolved. PBL requires that teachers adjust to the role of facilitator/ mentor/ coach. This is similar to the role we assume as a supervisor of graduate research students. However, we have adjusted that attitude and approach so that we can use it with groups of 100+ students. Secondly, PBL is more than just learning subject knowledge. Most versions of PBL provide an opportunity to draw on and develop a wide range of processing skills, especially the elements of lifetime learning. Including these required, additional abilities changes the way we create the learning environment and changes what and how we assess.

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BACK TO PBL