

PROBLEMS AND PROMISES IN PROBLEM-BASED LEARNING

Michele Marinovich

Stanford University, USA

For many of those who practise it, Problem-Based Learning (PBL) has such enormous appeal that it is easy to overlook the many ways in which PBL goes against the grain of faculty and postsecondary educational life. While faculty are devoted to their discipline, eager to dispense knowledge, and content-oriented, PBL asks them to be student-centered, guiding rather than directive, and process-oriented. Faculty are also asked to put aside their predilection for the theoretical in favor of real problems and concrete applications. Perhaps, it is not surprising that PBL has made inroads only slowly and most successfully in professional education, where, among other things, the role of application is more obvious and valued.

But hard as PBL practitioners may have to work for acceptance of their approach, I am personally convinced that there are changes underway in American higher education that are potentially producing a climate much more favourable to PBL. Participants from Asia are invited to compare the situation in their own systems of higher education and to decide whether they too may be experiencing a more receptive environment.

In the United States, these changes include a renewed emphasis on undergraduate education, which - in conjunction with a growing assessment movement and increased attention to both learning theory and active learning approaches - is making it more likely that teaching methods, like PBL, that concentrate on improved student learning will be identified and appreciated. In addition, changes in American primary and secondary schools, especially in the teaching of science, are producing a generation of students more used to, and comfortable with, inquiry-driven learning.

Perhaps surprisingly, the zeal with which many American universities are pursuing instructional technology can also be favourable for PBL. As the use of technology creates new and, in some cases, unexpected situations for both students and teachers, pedagogy is receiving more serious attention than it has in the past. PBL - which seems particularly effective at motivating students and which doesn't depend on the traditional talking head - may receive a fresh examination. Faculty who worry that this generation of students is attuned to a multimedia, nontextual, nonlinear world may also be more receptive to PBL's emphasis on active student learning, student responsibility for learning, and problems that tap students' natural curiosity. Technology has even contributed to the construction of classrooms that are more flexible and thus more appropriate for PBL.

But even though the higher education environment may be turning friendlier, PBL advocates should pay particular attention to several factors that could affect how well they take advantage of their new opportunities. First, the research base is not yet firm enough for PBL advocates to state unequivocally that PBL results in improved student learning. Advocates

must conduct more rigorous studies or develop measures that are more likely to capture the gains PBL instructors think are happening. Second, they need to avoid “true-believer-ism” and to tolerate hybrid forms of PBL that may be easier for novices and skeptics to try. Third, they need to be frank about, and to address in helpful detail, the downsides of PBL, especially the frustration it can generate in both students and faculty. And, fourth, as PBL branches far beyond its early home in the medical environment, it must shed the baggage it may have picked up in the clinical setting and use the language of its new disciplinary homes.

Through attention to these and other concerns, PBL can take full advantage of the more favorable environment opening up to it.

INTRODUCTION

I will begin the paper by reminding the reader of the degree to which PBL goes against the grain of much of what faculty and their post-secondary institutions hold dear. I will follow that, however, with a review of some of the changes I see going on in American higher education that I believe are creating a climate much more conducive to PBL than we have had in the past. (Although I try to follow developments in Asian higher education, I will not claim authority in developments here and will let you decide how much of what is happening in the U.S. is applicable to you.) And, finally, I will be quite active in my “critical friend” role by advising you of some of the factors I think PBL advocates must be most aware of if they are to take full advantage of this more favourable climate.

Now when I first became involved with PBL through my work with the Stanford School of Medicine, I was enormously taken with its approach. I loved the emphasis on real problems, of a complex and open-ended nature (I’ll explain below why I am not using the usual PBL term for such problems, “ill-structured”), that appealed to students’ natural curiosity and had an obvious connection to what students would do one day. I became such a convert that I began to ask myself why the Medical School was reformulating only one course into PBL; why not the whole curriculum? When my office did workshops for the faculty who would now be “guide[s] by the side” rather than the “sage[s] on the stage” (Stinson & Milter, 1996, p. 40), I wondered why some faculty were less than enthusiastic about their new roles. Couldn’t they see how much better this new approach would be for their students? Couldn’t they see how much better it would be for the patients that their students, after they became doctors, would treat?

But as I spent more time with PBL, I recognized that its very strengths call for a set of characteristics in its practitioners and their environment that is not only incongruent with the values of most postsecondary faculty, at least in the United States, but is almost diametrically opposed to them. (It was cold comfort, as I read more on PBL, that some of its supporters, such as Stinson and Milter (1996), made the same point.) Why do I say this?

Let’s consider the characteristics of effective PBL instructors that are mentioned by Wilkerson and Gijsselaers (1996) in the concluding chapter of their very helpful volume *Bringing Problem-Based Learning to Higher Education: Theory and Practice*. They mention that the good PBL teacher “must be comfortable at relinquishing authority,” “exerting indirect control,” observing closely and skilfully, attending to both social and intellectual interactions, valuing process as well as the end goal (p. 103). Now these characteristics, while probably describing many of you, are hardly the profile of the faculty that I run into day after day on my campus or on the many other campuses I visit each year. In most cases, we are talking

about people so in love with a particular field that they devoted four to eight years of life, in what should have been their carefree 20s, to the almost monastic pursuit of disciplinary knowledge. As far as I can tell, what makes this devotion possible, and rewarding, is the depth of their passion for what they are studying. Given that, is it really likely that faculty will be student-centred rather than content-centred?

I asked Ed Bridges, now Professor Emeritus at the Stanford School of Education and author of the wonderful book *Problem-Based Learning for Administrators* (1992), a devotedly student-centred teacher himself, whether he thought most faculty at Stanford were inclined toward the habits of mind that PBL needs and expects. He answered that few faculty at Stanford, or elsewhere for that matter, were so inclined (personal communication, October 6, 2000). Now, Ed wasn't saying that faculty *couldn't* be this way, nor am I, only that the orientation from which they start is a far cry from the orientation effective PBL teaching needs.

And PBL isn't just student-centred, it's also application-oriented. This stress on the value of the practical also goes against the grain of academia, especially in terms of its power structures. On campuses, don't physicists, in general, have more power than sociologists or, if not more power, a higher status? Now, there are many reasons for this having to do with the age of a field, its grant-attracting abilities, its external awards (there is no Nobel Prize for Sociology!), but part of this equation is the stage of development of theoretical, especially strongly theoretical, frameworks in the field. Pure mathematics is almost always valued above applied math, pure physics above applied physics, and so on. In their attitudes toward students, I find faculty especially frustrated by students' preference for the example over the theory, for the concrete over the abstract.

So what does this have to do with PBL? Simply that PBL implies respect for the particular, the concrete, the application rather than the theory. PBL does not stop at the application, of course; its goal is to use the particular to help students better grasp the theoretical. But faculty care very much about implicit messages and for some faculty it is uncomfortable to seem to give in to students' distaste for the abstract by letting them enter a field through its practice rather than through its theory.

At the risk of disheartening you, I'll mention just one more aspect of PBL that seems to me to be a real challenge for most faculty. This is the authority that a PBL teacher must mute, if not give up. In the Medical School example I am most familiar with, faculty went from being lecturers on the topic of their specialty to facilitators of a small group of medical students who tackled six or seven topic areas in which the faculty member was not an expert. In many cases, the faculty member learned right along with the students. In a workshop that we organized for these faculty on their new facilitators' responsibilities, we asked the participating doctors to role play a sample session with students on a topic they were not expert in. I remember vividly the senior faculty member, an eminent specialist, who folded his arms and glowered at us "I don't do role plays." In his own way, he made it very clear that he was not about to give up the authority that he had enjoyed his entire professional life.

I could go on regarding the aspects of PBL that seem to me to be very antithetical to the profile of your usual postsecondary teacher and institution, but most of you are probably all too aware of these already! So let me turn now to what I hope is the more optimistic part of my paper. And this has to do with the changes going on in American higher education, for a variety of reasons, that I think are beginning to produce a climate that is much more favourable to PBL. (As noted, I will leave it to you to decide whether the changes in the

United States that I highlight are also happening in your institutions.) I will mention six developments.

One of the most important changes regards the renewed emphasis on *undergraduate* education at research universities, which still tend to be the trend-setters in American higher education, and on rethinking *how* undergraduate education is conducted. One of the best distillations of this new attitude can be found in the 1998 report of the Carnegie Foundation for the Advancement of Teaching-funded Boyer Commission on Educating Undergraduates in the Research University. Called the Boyer Report in honour of the Carnegie Foundation president who had recently passed away, this document both summarized the pressures on undergraduate education at research universities and included a blueprint for change. Significantly, it called for “widespread and sweeping reform” that would change not so much the content of undergraduate education but its delivery. What the report specifically suggested was not precisely PBL but is surely close enough to PBL to be heartening.

The inquiry-based learning urged in this report requires a profound change in the way undergraduate teaching is structured. The traditional lecturing and note-taking, certified by periodic examinations, was created for a time when books were scarce and costly . . . This delivery system persisted into the present largely because it was familiar, easy, and required no imagination. But education by inquiry demands collaborative effort; traditional lecturing should not be the dominant mode of instruction in a research university.

The experience of most undergraduates at most research universities is that of receiving what is served out to them. In one course after another they listen, transcribe, absorb, and repeat, essentially as undergraduates have done for centuries. The ideal embodied in this report would turn the prevailing undergraduate culture of receivers into a culture of inquirers, a culture in which faculty, graduate students, and undergraduates share an adventure of discovery (p. 16).

Now, we all know that reports can sit on a shelf and have little impact but I can testify that, on my campus, the Boyer Report was seen as important confirmation of a recommitment to undergraduate education that former President Gerhard Casper had already initiated, and that its recommendations were seriously discussed. I also have no doubt that many of its recommendations, especially the emphasis on smaller classes and more direct faculty contact with students in the freshmen and sophomore years, have influenced many institutions.

But the emphasis on undergraduate education has not been the only post-secondary current helpful to PBL. Other developments, especially the emphasis on assessment, active learning, and technology, have also contributed to a warmer climate. Let’s start with the assessment movement. Resulting from a combination of political demands for increased accountability in higher education along with a scholarly interest in moving from input measures of higher education to reliable output measures, the assessment movement has spawned efforts across the United States to gauge student learning in more authentic, interesting, and valid ways. Faculty also realized that if they did not get involved in well thought-out ways to measure the impact of their teaching efforts on students, then state legislatures in the United States might mandate bureaucratically attractive but otherwise shallow and narrow measures. In less than a decade, a whole literature (an excellent entrée to which is Gardiner, Anderson, & Cambridge, 1997), a set of conferences—led by the American Association for Higher Education (www.aahe.org)—and a long list of institutions have engaged in serious and prolonged efforts to measure student learning. Nor does the movement seem to be losing steam.

This movement, I would argue, could be very good news for PBL, since greater attention to assessment and the question of what is being evaluated in student learning might yield measures that, as Barrows (1996) has put it, are no longer “insensitive to the cognitive and behavioural differences that are observed in PBL” (p. 10). By engaging significant numbers of faculty in thinking about what kind of student learning their institution is trying to stimulate and how to capture that learning more fully, the assessment movement may also encourage faculty to pursue alternative teaching approaches, like PBL, that concentrate on producing long-term, significant learning gains.

Similarly, the emphasis on active learning that is gaining ground on so many American campuses creates a soil more fertile for those who would sow PBL. Active learning doesn't necessarily mean PBL, of course; it can be accomplished through relatively small adaptations of the lecture method, such as Harvard Physics Professor Eric Mazur (1996) describes in his *Peer Instruction*. But faculty who begin to recognize the importance of students taking responsibility for their learning in such formats as think-pair-share are one step closer to the PBL approach, or so I would argue.

I would also argue that the preoccupation with technology on so many American campuses, including my own, may help PBL. How can that be, especially when technology is consuming so many resources that those of us with a pedagogical rather than a technological bent would like to see invested directly in teaching? Use of technology, whether in the traditional classroom or in distance learning, inevitably raises questions of what effective teaching and learning are. What is the role of asynchronous web-based discussion groups in a traditionally organized humanities class? Can virtual labs take the place of actual labs in a distance education science course? Can students form effective collaborative work groups when members of a class are distributed on different campuses and connected only by the web? When such questions are being pursued, faculty are one step closer to wondering how their overall instructional approach is affecting their students' learning.

Ed Bridges pointed out to me another effect that technology has had that benefits PBL, and that is in the area of facilities. Generally speaking, PBL needs flexible classrooms, with moveable rather than fixed seats. Now Temasek Polytechnic, which is hosting this conference, was built from the beginning with the kind of classrooms that support innovative teaching. But on my campus, until faculty demanded flexible classrooms appropriate for students using computers, and especially PowerBooks, there were lecture halls and seminar rooms but almost no other kind of classroom format. As a faculty member, if you want to try PBL now, chances are you WILL be able to find a classroom that's appropriate.

Finally, faculty also tend to be aware of, though not necessarily appreciative of, the effect that technology has had on their students' experiences and presumed expectations. Faculty worry that this is a generation with short attention spans, an orientation toward the visual rather than the textual, and with a need for quick and frequent gratification. Many faculty assume that students nowadays want variety, movement, activity. And though, again, this does not guarantee that faculty will try PBL, it makes it slightly more likely that faculty will be interested in ways of gaining and keeping their students' attention. PBL can claim to make the classroom a place where students are much less likely to become disengaged. As Professor Bridges puts it, students don't sleep in a PBL class (personal communication, October 6, 2000.)

Changes in the K-12 experience of current and future American college students are also conducive to PBL. The American Association for the Advancement of Science (see its Project

2061 website, <http://www.project2061.org/>), the U.S. Department of Education (see the website of its National Centre for Improving Student Learning and Achievement in Mathematics and Science, <http://www.wcer.wisc.edu/ncisla/>), the National Research Council (see its *National Science Education Standards*, 1996), and many other organizations have pushed inquiry-based science and mathematics education in American primary and secondary schools. They have urged that science should be taught, especially to novices, the way it is conducted, through questions, through a lively engagement with real problems. In such books as the National Research Council's *Science Teaching Reconsidered* (1997), this same approach to science education is also advocated for the university years. Inquiry-based learning is a natural ally to the PBL movement.

Finally, almost every college or university nowadays worries about not only its students' current learning but their *lifelong* learning. A highly competitive global economy has put a premium on graduates who are equipped to continue to teach themselves the latest developments in their own field or who can quickly get up to speed in a new field. When the half-life of an electrical engineer is down to two or three years (<http://services5.ieee.org/organizations/eab/gregcolumn17.htm>), *what* a person knows is far less essential than *how* she or he knows it. With its emphasis on student responsibility for learning, the importance of process as well as task, and internal rather than external sources of motivation, PBL seems well suited for a world that is demanding the skills of lifelong learning.

There is a final, important topic that I would like to discuss and where I hope to be PBL's critical friend. This is where I would like to suggest some steps that I think PBL and its practitioners must be ready to take in order to be able to take full advantage of the more favourable climate I am suggesting currently exists for it.

And the first of these suggestions is that PBL advocates must put a greater emphasis on producing the kind of convincing research studies that would effectively and extensively document its effectiveness. Now, with the help of one alumnus of the Stanford School of Education (Gary Lichtenstein of Quality Evaluation Designs) and one current graduate student (Angela Haydel), whose general assistance in preparing this paper I would like to acknowledge (while I, of course, remain responsible for any errors), I was particularly interested in any studies, especially meta-analyses, that documented the advantages of the PBL approach. But though there are many studies, and three particularly valuable reviews (Schmidt, Dauphinee, & Patel, 1987; Albanese & Mitchell, 1993; Vernon & Blake, 1993), the current research base for the superiority of PBL is not yet overwhelming.

Even if we put aside the methodological questions Wolf (1993) raises regarding the Albanese and Mitchell (1993) and the Vernon and Blake (1993) meta-analyses, conclusions regarding the strengths of PBL tend to be the weakest in the area of academic achievement. This is the precise area, however, that I would assert faculty care about most. Yes, there are advantages to PBL and, depending on one's values, these can be considered substantial advantages. But is the fact that students seem to enjoy PBL environments more and may even rate both their programs and their faculty more positively enough to convince faculty to devote considerable amounts of their scarcest resource, time, to the effort of redesigning courses into PBL?

The conclusion of one devotee of PBL, Professor Larry Leifer of the Stanford Mechanical Engineering department, is that PBL needs to develop a more extensive and convincing research base (especially outside the field of medical education, I might add). His office, the Stanford Learning Laboratory, has launched a seminar on PBL in which I am participating. In

rallying the troops at the conclusion of the first seminar on October 5, 2000, Professor Leifer called for more and more careful research to buttress PBL's claims.

Secondly, I urge you to avoid what Professor Bridges called "true-believer-ism" (personal communication, October 6, 2000). No matter how strongly you believe in PBL or how firmly you are convinced of its superiority as a teaching approach, you are more likely to influence other faculty if you present PBL as an interesting alternative (hopefully, in the future, with some attractive research data to draw upon as well!) rather than as the one best way to teach. My office has found in general that faculty loathe being told how to teach. Even faculty who are experiencing low student evaluations and have sought help still seem to want suggestions, not directions.

In the same vein, I hope you will be supportive of faculty who choose to teach "hybrid" forms of PBL rather than pure PBL. Now I realize that there are real dangers to mixing elements of traditional teaching with PBL. In an article for the newsletter (*CDTL Brief*) of the Centre for Development of Teaching and Learning here at the National University of Singapore, Professor C. Y. Kwan (2000) of McMaster University even likened using PBL to enhance the traditional lecture format as "using the slide-rule to aid computer calculation." But I would argue that the advantages of allowing faculty new to PBL to start off small and low-risk outweigh the admitted disadvantages.

Along with avoiding "true-believer-ism," I hope you will consider alliances with your campus teaching centre, if you have one, or with colleagues who are not practising PBL but who are just as concerned with student learning as you are. One of the things that has kept me in the work of faculty development for over two decades is the love of teaching and students that I find even in Stanford's very research-oriented faculty. I would point to Professor Doug Osheroff, who won the 1996 Nobel Prize in Physics, and yet teaches with enormous zest a seminar on photography for freshmen. Or, I think of his colleague, Assistant Professor Kathryn Moler of Applied Physics, who in spite of all the pressures of being on the tenure-track not only voluntarily teaches an introductory physics course but chooses to do it in the very time-consuming style of Harvard Professor Eric Mazur, whom I mentioned earlier. These faculty are not teaching PBL, but they care deeply about teaching and are your natural allies in creating campuses that are more student-centred.

Making common cause may become especially important if the mandated competency testing that often accompanies demands for assessment in the U.S. gains further momentum. Let me be clear here that I am not contradicting myself. As I had mentioned earlier, I do believe that by increasing the focus on measuring student learning outcomes the assessment movement can be quite favourable for PBL. But the same desire for accountability that helped fuel assessment has also spawned demands for competency testing, especially by state legislatures. The states of South Dakota and Massachusetts already have testing programs; a battle over whether a program should be adopted has begun in the state of Texas (Schmidt, 2000). PBL advocates may have particular reason to fear that such tests will not capture the kind of knowledge and skills they are trying to engender.

Thirdly, I hope you will be frank with each other and your colleagues about the down sides of PBL. When one is fighting for the acceptance of an idea, it can be tempting to soft-pedal the difficulties. Undoubtedly, I have done that myself when describing the work of my Centre; I usually choose to talk about the faculty who use us rather than the faculty who don't. So it is natural that most of you want to talk about the successes you've had with PBL, not the difficulties. But if the difficulties are not mentioned and discussed, then faculty who try the

method and have problems are liable to become discouraged and doubt their own skills for this approach. Professor Bridges was again very helpful here. He freely acknowledges that the downside of PBL is frustration, the frustration of students with what seems like the inefficiency of PBL and the frustration of faculty with the difficulty of covering content (personal communication, October 6, 2000).

Certainly when I've been involved in student evaluations of PBL classes, even the students who loved the class overall mentioned with special emotion in their voices the times when they felt they were spinning their wheels, the times when they wanted the teacher to step in. They know why the teacher didn't step in and why it was important that he or she didn't, but they were still frustrated. I wish the literature said more about this and what, if anything, to do about it. As I write this, I don't know what all of you have chosen to cover in your papers, but I hope that at least some of you tackled the question of your own or the students' frustration. Fenwick & Parsons (1997) have written about still other possible downsides of PBL, raising questions about who decides what is problematic, whether students would benefit from constructing problems themselves, and whether solving problems in the PBL context is really that similar to what students would do in a real life situation. In addition to these real concerns, grading in the PBL context is another area where those of you who have laboured in these fields for some time need to share more of your expertise and your solutions. Even in the familiar context of traditional teaching, faculty agonize over grading. When you add in the complexities of trying to evaluate work done in groups and on questions which deliberately have no obviously right answers, you have created a situation so complex that some faculty feel overwhelmed.

Fourthly, as PBL spreads beyond the medical context in which it has had its most enthusiastic welcome, be aware of unnecessary baggage from the clinical setting. An obvious example is the use of the term "ill-structured." Within the PBL world, but practically nowhere else, it is high praise to call a problem "ill-structured." We have to realize, however, that for humanists, social scientists, and probably most scholars, the term "ill-structured" bears negative connotations. We have to describe in language familiar and appropriate to them the kinds of problems PBL entails.

With its emphasis on the student, on his or her natural curiosity and internal motivation, on problems that are real and complex, PBL and those who practise it constantly remind all of us in higher education of our true mission. May the environment for implementing PBL indeed become more favourable and may the dedication of PBL practitioners bear fruit in the knowledge and learning skills of their students and in the respect of their peers and institutions.

REFERENCES

- Albanese, M. A., & Mitchell, S. (1993). Problem-based learning: A review of literature on its outcomes and implementation issues. *Academic Medicine*, 68 (1), 52-81.
- Barrows, H. S. (1996). Problem-based learning in medicine and beyond: A brief overview. In L. Wilkerson & W. H. Gijsselaers (Eds.), *Bringing Problem-Based Learning to Higher Education: Theory and Practice*. New Directions For Teaching & Learning, No. 68. San Francisco, CA: Jossey-Bass.
- The Boyer Commission on Educating Undergraduates in the Research University. (1998). *Reinventing undergraduate education: A blueprint for America's research universities*. Stony Brook, NY: SUNY Stony Brook.
- Bridges, E. M. (1992). *Problem-based learning for administrators*. Eugene, OR: ERIC Clearinghouse on Educational Management.
- Committee on Undergraduate Science Education. (1997). *Science teaching reconsidered: A Handbook*. Washington, D.C.: National Academy Press.
- Fenwick, T. J., & Parsons, J. (1997). *A critical investigation of the problems with problem-based learning*. ERIC No. 409272.
- Gardiner, L. F., Anderson, C., & Cambridge, B. L. (Eds.). (1997). *Learning through assessment: A resource guide for higher education*. Washington, D.C.: American Association for Higher Education.
- Kwan, C. Y. (2000 August). What is problem-based learning (PBL)? *CDTL Brief*, 3 (3), 1-2.
- Mazur, E. (1996). *Peer instruction: A user's manual*. Upper Saddle River, N.J.: Prentice Hall
- National Research Council. (1996). *National science education standards*. Washington, D.C.: National Academy Press.
- Schmidt, H. G., Dauphinee, W. D., & Patel, V. L. (1987). Comparing the effects of problem-based and conventional curricula in an international sample. *Journal of Medical Education*, 62 (4), 305-315.
- Schmidt, P. (2000 October 6). Competency tests questioned. *Chronicle of Higher Education*, A 35-36.
- Stinson, J. E., & Milner, R. G. (1996). Problem-based learning in business education: Curriculum design and implementation issues. In L. Wilkerson & W. H. Gijsselaers (Eds.), *Bringing Problem-Based Learning to Higher Education: Theory and Practice*. New Directions For Teaching & Learning, No. 68. San Francisco, CA: Jossey-Bass.
- Vernon, D. T., & Blake, R. L. (1993). Does problem-based learning work? A meta-analysis of evaluative research. *Academic Medicine*, 68 (7), 550-563.
- Wilkerson, L., & Gijsselaers, W. H. (1996). Concluding remarks. In L. Wilkerson & W. H. Gijsselaers (Eds.), *Bringing Problem-Based Learning to Higher Education: Theory and Practice*. New Directions For Teaching & Learning, No. 68. San Francisco, CA: Jossey-Bass.
- Wolf, F. M. (1993). Problem-based learning and meta-analysis: Can we see the forest through the trees? (Commentary). *Academic Medicine*, 68 (7), 542-544.