Reflections ON PBL

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What Students Think of PBL

Preparation for an Uncertain World

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Director of Academic Affairs,

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The turmoil in the economy around us is hard to ignore and so are the continuing conflicts arising from ideological and political differences. We are constantly reminded that it is an uncertain world out there. Amidst all these do we need to suggest a crisis in education too? Strangely, a significant proportion of academics at institutes of higher learning are oblivious to the serious concerns raised and debated at nearly every major conference on education.

Many people believe that education is about acquiring knowledge. Yet educational qualifications mostly boil down to success in answering a set of questions which are usually predictable in certain known ways, rather than demonstrating knowledge. In this regard, the case of science and technology education is more poignant. My experience has been that for many among those carrying higher education qualifications in science and technology areas, the most troublesome among all is a question asking for a demonstration of the knowledge that is supposed to have been acquired when gaining those qualifications. School curricula and syllabi are detailed to exacting standards but the graduates have difficulty in pinpointing what exactly they know. Many blame the elements of time for taking away the knowledge they claim to have once acquired. Well, if that is the truth, then one possibly cynical way to make things even is to print educational certificates in ink that also fades with time, or else, it will be unfair to those who rely on certificates for gauging the level of knowledge a person has!

What should one be looking for in formal education at an institution of higher learning? Indeed education can be for its spiritual value, in which case, the issues are mostly personal. Justification for public faith in education and spending public funds for education comes from the economic value of education, that is, value in terms of generating wealth for the community or finding gainful employment for playing an economically meaningful role.

A question that pops up readily in this context is "what are the skills and abilities that would enable individuals to find meaningful roles in the economy?". Developments and trends in the past have taught us that if one is looking for an answer like "electronics" or "Bluetooth technology" then finding an answer that makes sense would be tough, because it has become quite clear that in predicting the needs of even the near-future to a workable accuracy is very difficult, if not impossible. Knowledge is created at a fast pace, despite the difficulties educators face in getting students to acquire knowledge at some pace, making once valued knowledge obsolete and less useful within a short span of time.

So it is a case of twin riddles. One riddle is that of disparity between the syllabus detailed in the curriculum and the knowledge actually acquired by the graduate. The other is that of dubious practical significance of the kind of knowledge that been attempted to be imparted to the students. The two riddles are interconnected. If the disparity noted in the first is too large, it does not matter if the education attempted is of the appropriate kind. If the knowledge to be imparted cannot be identified to a reasonable accuracy as mentioned in the second then it does not matter if there is a disparity as claimed in the first. Therefore, both riddles need to be sorted out simultaneously if the aforementioned problems of education are to be meaningfully addressed.

At the Republic Polytechnic (RP), we accept that knowledge is associated with a context, and learning too. A context packaged with some kind of a challenge or difficulty can make someone learn, but it does not guarantee learning. Indeed, nothing can guarantee learning – only the learner can ensure that. A context nevertheless offers a better way of learning than an elaboration on a structured element of a syllabus, identified by experts with the help of hindsight after developing the subject knowledge over a long period of time through exerting a lot of effort.

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Inside This Issue

Editorial

PBL & the Student

In this edition we explore the students' experience with Problem Based Learning (PBL).

No one would argue with the obvious that the students' experience in schooling, whether it be primary, secondary or tertiary, is learning. But perhaps what is less obvious is what is perceived as learning.

Certain traditions define learning as the acquisition of a body of knowledge through a process of absorption, wherein the expert (or their proxies i.e., teacher, the textbook) imparts known facts and truths to the novice.

However, using a more radical epistemology, learning can be conceptualised as an act of constructing knowledge. It is a process of construction or negotiation because there is an absence of absolute authority, making knowledge both problematic (in that all that is known is debatable) and socially determined. Because knowledge is negotiated, learning, instead of an absorption of facts from the expert to novice, requires pedagogies that foster critical discussion, debate and interaction between experts and novices, students and teachers, scientists and layman.

In the latter conception of learning, the student is more than a passive recipient of ideas. The learner must be willing to engage in an ongoing dialogue over competing views of the world. To be able to participate in this dialogue , students must do more than know how to access specific disciplinary or professional information, write essays, calculate, conduct experiments, programme etc. They must develop the necessary skills that will enable them to conceptualise, judge, make sense, and evaluate. These skills are less concrete in that they are not easily defined in terms of declarative knowledge, but they are exactly what will enable students to engage in critical dialogues.

In PBL, students are asked to respond to "real world problems". In this setting, students quickly realise that lists of facts or information are insufficient to meaningfully address these problems . Real world problems are complex, multi-faceted and contextual such that it is not wise or even possible to attempt to list or tell students all the information they may need to know to solve problems. Instead, students should be given the freedom and responsibility to explore the problem as they see fit. PBL as it is widely practiced encourages students to argue their view of the problem and allow others the right to contend and counter-critique. Teachers also participate in this process, adding their own views using the same rules of evidence expected of the students.

There is no doubt that PBL places huge expectations on the learner. Many students find the experience of doing PBL daunting and demanding and yet many are also able to see it as being exciting and rewarding (RP's own student feedback is polemic in nature). Many educators embrace PBL not simply because it's fashionable but because it may more accurately account for the most critical element of the student experience in education - **learning**. ◘

Glen O'Grady,
Editor

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The vision of RP's education approach is based on the belief that formal education shall be all about learning how to learn. Acquiring knowledge is definitely a part of the process, because learning how to learn cannot happen in a vacuum, and not because of a claim that a particular piece of knowledge is definitely required at the future workplace. In today's world, most people learn at the workplace itself most of what they need to do their work well. Another way of putting this is that things people know best are usually learned at places where they used that knowledge. Abilities developed through formal education shall accelerate that process of learning at the workplace, which has to happen unceasingly throughout the whole life. So the curriculum has to be designed with this desired outcome of acceleration of learning at workplace in mind, instead of trying to include the knowledge perceived to be needed at an unknown future workplace.

When designing the pedagogical processes at RP, no process or notion was considered sacred. Development of a symbiotic composition of a set of educationally meaningful routines was considered as a key feature. Elements like taking up a challenge, reading, searching, communication, convincing others, learning from others, evaluation and judgment were incorporated into the daily routine of activities. Most people expect to see lectures and tutorials at institutions of higher learning, just like they expect to see mirrors and scissors at hair salons. The usual question that comes back when I mention that we do not give lectures is, "how are you teaching then?" I have never found an answer for why a specific method meant for delivery or dissemination of unsolicited information is given such a "sine qua non" status when all one should legitimately be expecting to see is learning.

Views about education are diverse even among the minority who question the validity of widely held beliefs about education. This disunity among enthusiasts allows educational practices at institutions to be determined by traditions and past legacies instead of reasoned evaluation. If measurement of learning were a relatively easier task, many disagreements about educational practices could have been resolved, but unfortunately the issue of measurement itself is fraught with disagreements. Traditional beliefs about examination systems and expectations complicate the issue here. In addition, complexities arise due to differences in modalities of diverse subject disciplines.

Regardless of differences in opinions, the ultimate question to be answered about an education process is "are the students better off in terms of their readiness to the world?" No - two distinct processes yield identical results in practice and therefore some processes would be invariably better than others with reference to a specified outcome. At RP, we believe that our one-day-one-problem approach of PBL is a better way of providing a holistic and meaningful education. For the community, we believe that RP's approach to education offers a refreshing alternative to the conventional lecture-tutorial based system. ◘

PBL Is Like Learning a ***New Sport***

Annabelle Cheong Jiashan (SIT) and Angie Lim An Qi (SAS)
(!st year RP students)

Our first contact with Problem-Based Learning (PBL) was rather nervewrecking. We watched a strange sport with grown-up men chasing after a ball – it looked a bit like soccer, rugby and volleyball all tossed in like a bad salad. Our minds went blank initially. What in the world was this all about?

Following our initial confusion, enlightenment dawned. We learnt to manage our panic attacks with a strategy which encouraged us to list down what we knew, what we didn't, and then what we needed to find out. We realised (to our pleasant surprise) that we did know a few things. Some of the guys also chipped in their knowledge about certain sports they played. Armed with this, we marched off to the library and sourced the Internet for more information about this not-so-strange sport called "Aussie Rules".

PBL can be unnerving because how well you learn depends on your resourcefulness, your ability to work well with your team and your research skills. The simple but revolutionary idea that problems should come before answers is what drives our learning. It begins with a problem that puts you in the driver's seat, and using your previous knowledge, hunches, and sometimes your wildest ideas, you start your search for a solution. Many of our classmates are still adapting to this new learning environment. Some feel the pressure, while others see it as an opportunity to get to interact with their team members better. The general response can be summed up this way: PBL generates creativity and a headache as well.

Through PBL, we've stood out from our peers in other schools, in the way that we learn and how we are taught and graded. Most of us believe that given some time, our anxiety will gradually be replaced with curiosity. Just like learning a new sport like "Aussie Rules", we will learn to not only play the game the hard way (through tackles and hard knocks), but to play it well with the help of our teams mates and support from our friendly facilitators. ◘

The Best Deal Competition @ SJI

Chang York Boon
Centre for Innovation & Enterprise

Republic Polytechnic's Centre for Innovation & Enterprise (CIE) undertook a seven-week Problem-Based Learning (PBL) enterprise programme with St Joseph's Institution (SJI) starting from 6th February 2003.

This programme was designed to equip secondary three students with the necessary business skills to explore creative business ideas and to formulate business plans.

The "The Best Deal" project at SJI was carried out in two phases consisting of three-hour sessions on a weekly basis. The first phase of four weeks equipped students with the foundations of enterprise skills using PBL pedagogy. In each of the four sessions, students were not taught by facilitators on any enterprise skills. Instead, they were shown various real world problems to be solved by the students themselves working in groups of four. New knowledge was acquired along the way as a result of managing and solving these problems and the sharing among their peers with the RP lecturers as facilitators. Students also sought and synthesized their findings during the self-directed learning in their own groups.

The second phase of the programme saw the commencement of preparation for the "Best Deal Competition" where students competed with one another on the feasibility of their business ideas. After two rounds of presentation, four groups were short-listed to compete in the final "Best Deal Competition."

Students who participated in this SJI-RP Best Deal Collaboration project unanimously agreed that they have benefited tremendously from this enterprise programme. This programme had not only provided the students an opportunity to learn using the PBL methodology but also to hone their entrepreneurship skills. ◘

Winners of the "Best Deal" Competition

Proficiency Development Programme (PDP) June 10 – 27

Leo Kwang Lin
Office of Corporate Communications

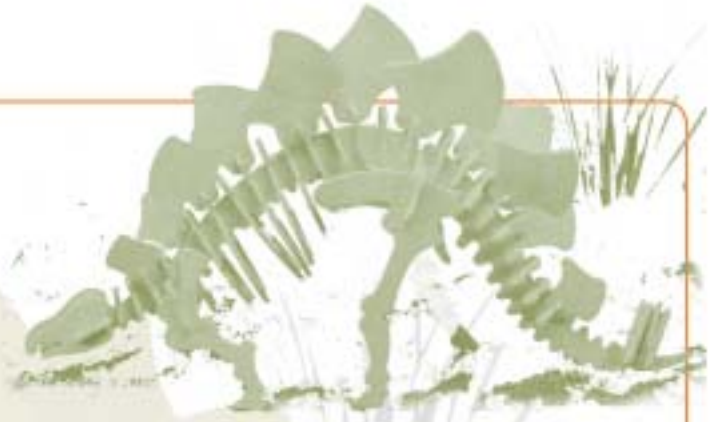
The March joint admission exercise attracted hundreds of hopeful applicants. Many were rejected because they did not have the required minimum grade of C6 in Mathematics and Science.

In order to help next year's applicants improve their chances of gaining admission, Dr Alwis designed the Proficiency Development Programme (PDP) for Secondary 4 students who were keen on joining a polytechnic but had difficulty in Mathematics and Science. When the schools were informed, response far exceeded our expectation. A total of 360 students from 8 schools signed up for the 35-hr programme spread over 10 days.

The PDP used a Problem-Based Learning approach. Every two days, the students received a new problem focusing on a 'tough' topic such as Trigonometry. In groups of 5, they worked on how to approach the problem under the guidance of their facilitator. For many students, this was the first time they 'studied' a subject with their peers in this manner. It felt strange, some of them said, to look at a problem couched in such a 'peculiar' way – it was totally different from the usual "O" level style. It was equally strange to have 'break-out' sessions where they relied on one another for a way to tackle the problem instead of hearing from their facilitator what the correct answer should be. On top of everything else, there was the group presentation at the end of the day to sweat over as they had to explain what the group did to arrive at the solution.

Many students accepted the challenge and rose to the occasion – to them, it was an exciting way to learn. They appreciated the PBL process as a way of learning content in a context and that they did not merely learn the solution to a given problem but more importantly, they understood the underlying issues better than before. At the end of the programme, many realised that the benefits of PBL were considerable: they became better at thinking through a problem, better at time-management and communicating what they know to their friends, and most significantly, they became more confident about themselves as learners. ◘

Whales and Dinosaurs



The cognitive skills and problem-solving module at Republic Polytechnic is focused on helping students develop the cognitive skills necessary to be able to be better problem-solvers. The PBL approach lends itself well to teaching cognitive skills because the process of thinking is often made explicit when reflecting upon the problem at hand.

The "Whales and Dinosaurs" problem aims to help students develop an understanding of the scientific concepts of prediction and extrapolation. Through their attempts to resolve three scenarios, students are expected to develop an appreciation of the limits in making predictions from inferences. The problem invites students to explore what reasoning processes are necessary to make informed predictions. Specifically students are challenged with fallacies that appear to be logical, but when considered more carefully reveal the need to be cautious in making predictions that stem from naive extrapolations of observation and data.

Whales and Dinosaurs

- One person rowing a boat can reach 10 km/h. Two persons rowing a boat can reach 20 km/h. 1000 persons rowing a boat can break the speed of sound.
- It takes 100,000 bricks to build a pyramid of a certain height. If we double the number of bricks, we can double the height of the pyramid.
- A Blue whale - bigger than that of the largest dinosaur - is the largest animal to inhabit the earth.

Explain which statements are correct and incorrect. Examine the limitations of making predictions from observations

The statements deliberately lead one to extrapolate an "unreasonable" or inaccurate outcome. However, in discussing the problem and through simple research and calculation, students will quickly realise that it is not possible to break the speed of sound with a thousand men rowing and that doubling the number of bricks does not necessarily lead to a doubling of the height of the pyramid.

One of the goals of science is to make useful predictions, and extrapolation is often used in scientific prediction. Students identify the common logical fallacy of making predictions on the basis of a few small facts and in justifying their solution, they will realise that statements one and two are erroneous. Students begin to develop an argument about the limits in making predictions based upon inferences.

However, in order to avoid students concluding that extrapolations are dubious and not useful, the third statement about whales and dinosaurs is included. This statement along with the very limited resources requires students to make a judgment about which animal is bigger. Besides debating the concept of what bigger means, students are forced in their presentation to draw a conclusion based on the data they have available to them. By taking into account physical limitations, student may conclude in a fairly confident manner (but with some tentativeness), that the larger animal is the whale. This helps students to realise it is possible to make reasonable extrapolations and that in society we often use extrapolation to make predictions about future outcomes, e.g. economic trends, weather reports etc.

By the end of the day, students should be more aware that predictive rules generally have a limited domain of applicability. To state the rule without stating its limits of validity is improper and poor thinking.

Students discover these outcomes through addressing the problems in teams and their own research. By addressing fundamental PBL process questions of "What do you know?", "What don't you know?" and "What do you need to find out?" students are encouraged to be more meta-cognitive than if they were receiving this information in a more traditional didactic setting.

Adapted from the applied research article, "A Comparison of Problem-Based Learning and Standard Curriculum Students: Three Years of Retrospective Data"

by Linda H Distlehorst and Randall S. Robbs (1998)

A three-year retrospective study was done to compare the academic performance of students in a reiterative Problem-Based Learning (PBL) curriculum with that of their counterparts in the standard curriculum. Three graduating classes' performance on a number of outcome measures such as the United States Medical Licensing Examination, clinical clerkship, and clinical practice examination performance were compared. The results indicate that the students in the PBL curriculum performed at least as well as, and in some instances better than, their counterparts in the standard curriculum. They also demonstrated strong clinical performance.

Reiterative PBL as referenced by Foley[1] and defined by Barrows[2] is one of the most powerful of the PBL educational designs, because it addresses four of the PBL objectives: structuring knowledge for use in clinical contexts, developing an effective clinical reasoning process, developing effective self-directed learning skills, and increasing motivation for learning. In this PBL design, after students have completed their self-directed study, they return to the patient problem in its original presentation and determine how they might have better reasoned their way through it; they also evaluate their prior reasoning and knowledge. Reiteration of the problem analysis and synthesis may lead to additional self-directed learning.

The standard curriculum since 1974 is organized around organ systems with the faculty's expected learning outcomes expressed in behavioral objectives. Faculty specifies what content and skills must be mastered, and also identify the resources with which students are to achieve mastery. The basic science disciplines are the primary units for the organization and delivery of content through lectures, seminars, and laboratories, augmented with some small group activities, such as patient-oriented problem-solving (POPS)3 sessions in Immunology and Pharmacology and case discussions in the Introduction to Clinical Medicine (ICM) course. Although there is some performance-based assessment using human and computer simulations, students are primarily evaluated with multiple choice examinations at regular intervals throughout each year.

In 1990, the Problem-Based Learning Curriculum (PBLC) was implemented as an alternate track. The track used real patient problems as the context in which students learn basic science concepts. The same basic science disciplines as those taught in the standard curriculum are integrated into the PBL experiences. No subject is taught separately. Although students are free to schedule or participate in any activity (a seminar or laboratory session) that they feel will improve their understanding of a concept or process, very few students actually participated in standard curriculum activities. The process used during the tutor session has been based on the clinical reasoning process used by physicians[3] to solve patient problems and the educational objectives of PBL. These objectives include the following: acquiring an extensive usable, integrated knowledge base; developing effective and efficient clinical reasoning skills; developing effective and efficient self-directed learning skills, including an internal motivation to learn, question, and understand; developing effective patient interaction skills (history taking, physical examination, patient education, and communication skills); and developing interpersonal and group skills that include giving and receiving performance feedback.

The primary assessment of student progress occurs in the tutor groups at the end of each problem and as an official assessment at the end of each unit, during which each student assesses himself or herself and then is assessed by each member of the group, including the tutor, on this curriculum's five objectives for PBL.There is an end-of-unit, performance-based examination constructed around three patient cases. This unit assessment engages students and faculty in a one-on-one oral evaluation of the significant basic science concepts for the unit, as well as providing an opportunity to evaluate students' clinical reasoning and self-directed study skills.

Discussions

PBL students have performed well on their clinical rotations. The analyses shows no difference between the PBL and standard curriculum. These results indicate that PBL students in the SIU curriculum are not disadvantaged in either basic or clinical science knowledge acquisition. Of greater interest is the students' performance in the clinical setting, particularly given the PBL's emphasis on the use of knowledge in solving patient problems as well as the continual development of clinical reasoning skills and because effective patient care is the whole point of medical education.

Regarding clinical performance, Albanese and Mitchell[4] review indicates that PBL graduates are "at least as good (in terms of cognitive framework) as those of graduates from conventional curricula, if not better". Vernon and Blake[5] report that PBL students are superior to students educated in standard traditional curricula and attributed this to the fact that PBL curricula emphasise the integration of basic and clinical science information in the analysis and resolution of clinical problems. Richards et al[6] report that their five classes of PBL students demonstrated significantly better clinical performance in their internal medicine clerkship study than their lecture-based students. ◘

Reference:

1 Barrows HS. A taxonomy of problem-based learning methods. Medical Education 1986;20:481–6.

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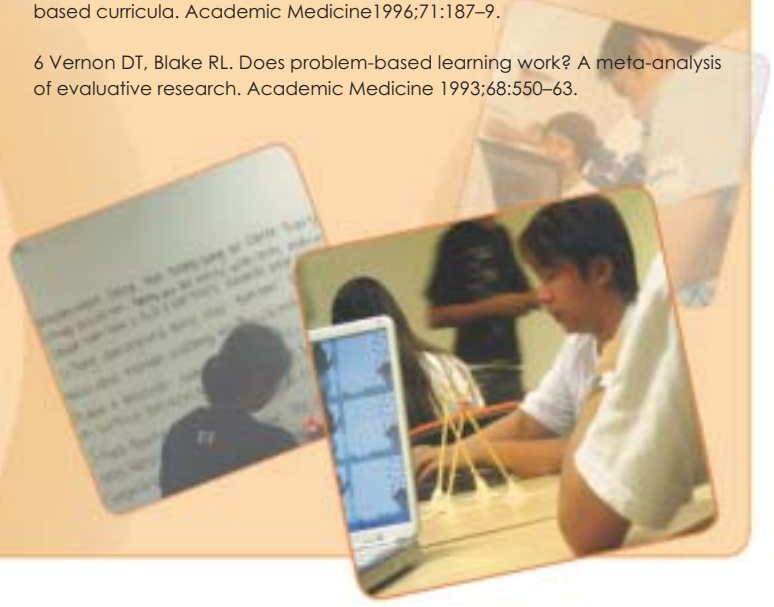
3 Barrows HS, Norman GR, Neufeld VR, Feightner JW. The clinical reasoning of randomly selected physicians in general medical practice. Clinical and Investigative Medicine 1982;5(1):49–55.

4 Albanese MA, Mitchell S. Problem-based learning: A review of literature on its outcomes and implementation issues. Academic Medicine 1993;68:52–81.

5 Richards BF et al. Ratings of students' performances in a third year internal medicine clerkship: A comparison between problem-based and lecture-based curricula. Academic Medicine1996;71:187–9.

6 Vernon DT, Blake RL. Does problem-based learning work? A meta-analysis of evaluative research. Academic Medicine 1993;68:550–63.



Coming to Terms with Student Opinion on PBL

"Opinion is like a pendulum and obeys the same law. If it goes past the centre of gravity on one side, it must go a like distance on the other; and it is only after a certain time that it finds the true point at which it can remain at rest."

Arthur Schopenhauer , "Further Psychological Observations," (1851)

A survey to find out the initial reaction of students towards PBL at the Republic Polytechnic was conducted on the 27 June 2003. A total of 159 students took part in the survey.

More than ninety per cent of students reported that PBL enhanced their ability to learn, helped them become independent thinkers and that the facilitator's feedback was useful to them. The open-ended comments, however, show a sharp "swing" between the opinions of students who had the same PBL experience. Table 1 shows a sample of comments.

Aspects Students Liked About PBL & Facilitation	**Aspects Students Disliked About PBL & Facilitation**
"To work in groups, thinking together as a team and solving the questions." "…able to work as a team and solving the problem without the help of the facilitator gives great satisfaction..." "It helps me to put up a positive thinking for maths thus triggered my interest in solving the problems." "…and learning through thought process rather than thick textbooks..."	"The worst thing is that we were told topics that we don't understand or learnt before. Therefore, it's hard for us to solve the question given." "...we have NO background in 'A' Maths. And we are expected to solve the problem. It will be better if we are given a small lecture before we start. Or at least teach us the foundation. Anyway, we are here to learn. But we are not taught anything and we are supposed to solve the problem. Outcome: We come out with a bad and wrong solution eventually." "The worst thing …is that, we do not know if we are working on the correct track. And, by the end of the presentation, we would then know that we are working on the wrong track. I think this is quite disheartening for someone to put so much effort into the question and in the end, only to get the wrong answers."

Table 1: Excerpts from Students' Comments

There appears to be a marked difference amongst the opinion of students. For example the desire for an 'authority figure' in the classroom would seem to negate the very aspects other students appreciated in the PBL experience.

Why is there such divergence in the opinion of students especially when it is considered these students share similar prior knowledge and experience in schooling? Why do some more easily embrace PBL while others struggle to accept it?

Savin Baden (2000) suggests that a person's learning experience is influenced by his notions of the 'self' (personal stance), learning (pedagogical stance) how he interacts with others (interactional stance).

For example, a student with a mindset of attaining top marks in the class (or conversely to do the least amount of work possible) may have an individualistic perspective (personal stance). This perspective may have a negative impact on the time and effort he will spend working in a team and may account for the expectations he has that the facilitator should provide 'answers and relevant information' so that their individual study time may be put to 'best use' by reviewing the answers (pedagogical stance). Furthermore, the student may have concerns about how discussion amongst peers is a 'waste of time' as it may lead to 'going down the wrong track' thus hindering rather than helping the person to learn and achieve his individual goals (interactional stance).

PBL focuses on the process of learning as well as the acquisition of knowledge and skills. The belief is that excellence in the learning process and its end product cannot be viewed separately. However, students whose personal pedagogical and interactional stance are inconsistent with this philosophy will need an extended period of time, exposure and practice in working from an alternative stance.

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Drawing support from research in PBL, institutions adopting PBL need to consider that students who are having difficulty in adopting PBL are likely to have views on the 'self', 'what is learning' and the value of 'interaction' which may be different from those espoused by PBL. To address these differences, it is necessary the PBL system that is employed (including how facilitators are trained to facilitate) constantly affirms and validates learning as a process rather than just about achieving specific objective outcomes. Furthermore, the aim of 'learning to learn' is fostered through students being asked to become more aware of how they connect their prior knowledge to their experiences of working on problems. Also students need to be made aware of the value of social interaction in forming their own ideas. And finally in dealing with personal change and their 'self' conception students need to come to an understanding that the concept of 'self' is a product of their experience which in a different environment is amendable to change.

At the Republic, we anticipate a maturing of opinion as students recognise and become more aware of the connections between the processes of PBL and the quality of their learning. ◘

References

Savin- Baden M, Problem-based Learning in Higher Education: Untold Stories, (2000) The Society for Research and the Open University Press, Buckingham, UK

Events

Professional Development in Teaching and Learning Conferences and Workshops

Conference / Workshop	Date	Location	Website
The 9th Annual UNESCO-APEID International Conference on Education: Educational Innovations for Development in Asia and the Pacific	Nov 4-7, 2003	Shanghai, China	http://www.unescobkk.org/education/apeid/conference/conf9/index.htm
Problem-Based Learning Foundational Workshop	Nov 10-14, 2003	Republic Polytechnic, Singapore	http://discovery.rp.edu.sg/home/CED
A Primer on the Maastricht Approach to Medical Education (International Visitors Workshop)	Nov 27-28, 2003	Maastricht University, The Netherlands	http://www.fdg.unimaas.nl/bib/workshop/
2004 Hawaii International Conference on Education	Jan 3-6, 2004	Waikiki, Hawaii	http://www.hiceducation.org/
The 5th Asia Pacific Conference on Problem-Based Learning: Pursuit of Excellence in Education	Mar 16-20, 2004	Kuala Lumpur, Malaysia	http://www.umcced.edu.my/conference/PBL/main.htm
Problem-Based Learning International Conference 2004: Pleasure by Learning	Jul 13-18, 2004	Cancun, Mexico	http://www.cem.itesm.mx/pbl2004/
The International Conference on Thinking XI	Jul 21-27, 2003	Arizona, USA	http://www.conferenceonthinking.org/

The Editorial team is looking for interesting research, articles, or comments related to PBL to include in this Newsletter which will be published three times a year. If you are interested in submitting an article (approx 500 words) please contact:

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