Do we get effective learners by using PBL?

Glen O'Grady & Jeanette Choy Lyn Fung

Centre for Educational Development (CED)
Republic Polytechnic, Woodlands Avenue 9, Singapore (738964)

ABSTRACT

Problem Based Learning (PBL) is widely recognised as an effective way of learning. Studies suggest that an effective learning environment is one where "deep learning" is fostered. This study briefly explores whether a particular form of PBL (practised by the Republic Polytechnic, Singapore) cultivates deeper learning.

This paper reports the effects of a one day one problem™ form of PBL on students' approaches to learning. Students' approaches to learning were measured using the SPQ when they first entered a tertiary level institution (Republic Polytechnic) after completing a minimum of 10 years of schooling. The study examined whether students' approaches to learning changed after their first year of academic life, having engaged in a unique form of PBL.

Analysis shows that the dominate approach towards learning for the majority of students entering Republic Polytechnic was achieving. At the end of their first year, there was a significant change in the way students approach learning. Although the achieving is still the dominant learning approach, students tended to have deeper learning motives while adopting achieving strategies.

KEYWORDS

Approaches to Learning, PBL, SPQ, Republic Polytechnic, One day one problem™

INTRODUCTION

The Republic Polytechnic adopts PBL for all its three year academic programmes. PBL is an educational strategy where learning is driven by a problem and students work in teams to define research and negotiate a response to the problem. The teacher plays the role of a facilitator who guides the students more on "how" to learn rather than "what" to learn. A problem may be presented in many forms such as a description of a difficulty, a curious outcome, an unexpected happening, or an event that requires either a solution or some explanation. In applying PBL, the Republic Polytechnic implemented a unique process termed as a one-day one-problem™ approach which entails students spending exclusively one whole day working on a problem that is centred around an idea or a concept. (O'Grady & Alwis 2002).

A review of primary and secondary education in Singapore undertaken by the Centre for Research in Pedagogy found that in many subject related classrooms (i.e. mathematics) it was

mainly "*teacher-centric with low-level teacher-student or student-student interaction"* (Yeo and Zhu 2005) and that students are mainly engaged in activities focusing on factual or rote learning. Similar findings about Chinese language lessons conducted in Singapore schools were also reported elsewhere (Liu 2005). As such, Republic Polytechnic's process of learning is very new to students since their primary and secondary education has conditioned them to think learning is the direct transmission of information from the teacher.

For an institution that wholly adopts a PBL approach aimed at changing and enhancing students learning it is worth investigating whether PBL fosters effective learning. Effective learning, according to Feynman (1999), is when someone is genuinely curious enough to ask questions and then find an answer they can defend in a manner that is convincing to themselves and others. Hence, effective learning is not just accepting wisdom but trying to find why this wisdom is accepted. Watkins (2002) suggest that learning is an activity of construction, handled with (or in the context of) others, and driven by learner's agency and that "effective learning is all of these at their best, plus the monitoring and review of whether approaches and strategies are proving effective for the particular goals and context".

These descriptions of effective learning relate closely to what Biggs (1987) has described as "deep learning". An approach to learning can be defined in terms of the motives and strategies that learners employ. A deep learner's motive stems from an intrinsic interest to learning whereby students relate content to personally meaningful contexts. This requires higher cognitive strategies like searching for analogies and theorising. This deep approach contrasts with a surface approach to learning wherein the motive for learning is due to extrinsic factors like meeting the necessary course requirements. A typical strategy employed for a surface approach is rote learning. A third approach is achieving. The motive is similar to a surface approach which is focused on the product such as obtaining the highest grade. The strategies employed are to maximise the chance to obtain higher grades by various means even if it requires a high level of effort to learn the topic (similar to deep strategies).

AIM OF STUDY

Biggs (1999) has described PBL as an active learning approach that leads to deep learning. Research on PBL has demonstrated that students engaged in PBL develop greater conceptual understanding of concepts (Martensen 1985 and Eisenstaedt 1990). Further research has found that solving a problem before instruction, rather than after instruction (the more conventional approach to education) led to better transfer of problem solving skills (Needham and Beck 1991) and that PBL students could advance many more causal explanations (Patel 1991) and integrate their knowledge better than non PBL students (Boshuizen and Schmidt 1990). One study found that students who discussed a problem relevant to a topic displayed more attraction to a subject and were more interested in studying the relevant literature (De Volder 1986).

This study examines whether PBL as practised by the Republic Polytechnic cultivates deeper learning.

METHOD

The authors measured students' approaches to learning using the SPQ (Study Process Questionnaire). The measurement was done in two stages. The first stage was in the second week of the students first semester at the Republic Polytechnic (Academic Year 2005/2006). Ten classes (each consisting of 25 students) of first year students were randomly selected to take part in this study. 165 students responded to the survey. The survey was administered again in the second stage (the end of students first year at the Polytechnic) to the same batch of students who responded in stage one. The total number of students who responded to the survey in the second stage was 125, constituting a response rate of about 76% of the students from the first stage. The results of the survey were analysed to see whether students' approaches to learning had changed after their first year of academic life at the Republic Polytechnic, having engaged in a unique PBL methodology.

Measurement Instruments

The SPQ, devised by Biggs, is a 42-item questionnaire[1]. It has been validated and extensively used in studies of learning in tertiary institutions. Each of the 42 items is a self-report statement about either a motive or strategy related to learning. "Motive" refers to the reason or motivation that student had for undertaking learning and "Strategy" refers to the methods and habits students engage in to accomplish a learning task. The respondents rate themselves on a 5-point likert scale. A combination of scores relating to motive and strategy reveal a dominant approach to learning, either "Deep", "Surface" and/or "Achieving".

RESULTS

Dominant approach to learning

The dominant approach to learning is obtained by looking at the highest score each student obtained for the three approaches to learning. Figure 1 reports the percentage of students that have different dominant learning approaches. The dominate approach in stage one and two is an Achieving approach. However the results also show that in stage two there is an increase in the number of students whose dominate approach to learning is deep, and a decrease in the number of students whose dominate approach is surface or achieving.

[1] Some of the statements in the 42-item SPQ questionnaire have been amended to correspond with the method of delivery in RP. Despite the amendments, strict deliberation has been administered to ensure that the original intention of the statement has been retained (APPENDIX A).

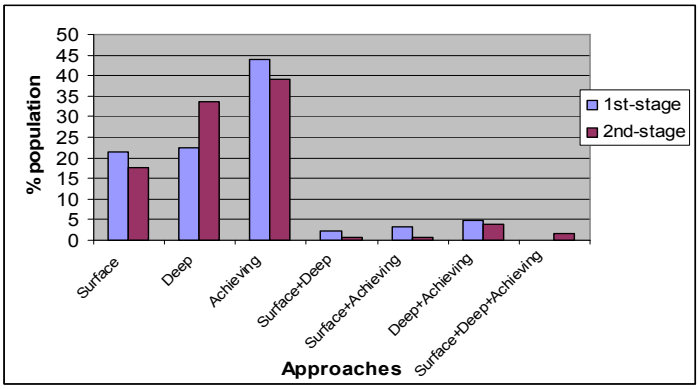

Figure 1: Dominant learning approaches among REPUBLIC POLYTECHNIC students

Changes in the three learning approaches over the first year of study

Figure 2 shows differences in the mean scale scores for the different learning approaches over time. The dominant learning approach for both stages is achieving.

Using Paired-Samples T-Test, there is a significant difference in scores between the two different stages for deep learning approach (t=-2.674, p = 0.009), which suggests that average increase in deep approach per student is not due to chance variation and may be attributable to the PBL.

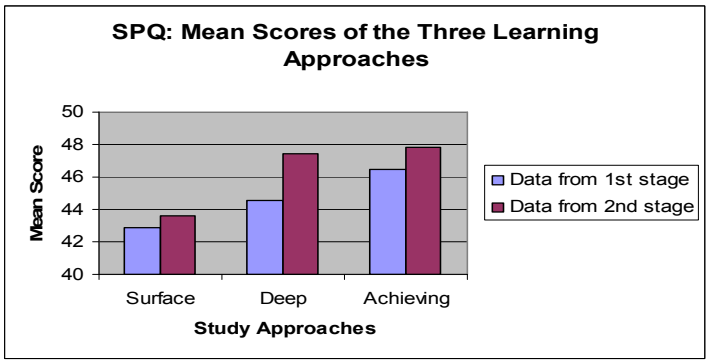

Figure 2: Mean scores of learning approaches

Approaches Learning: motives and strategies subscales

A paired-samples T-test (see Figure 3) was conducted on each of the motives and strategies subscales, in order to further investigate how students developed, It was found that the Polytechnic students' deep motives changed significantly (t=-3.481, p=0.001).

Furthermore, there was a significant increase in the adoption of achieving strategies (t=-2.156, p=0.033).

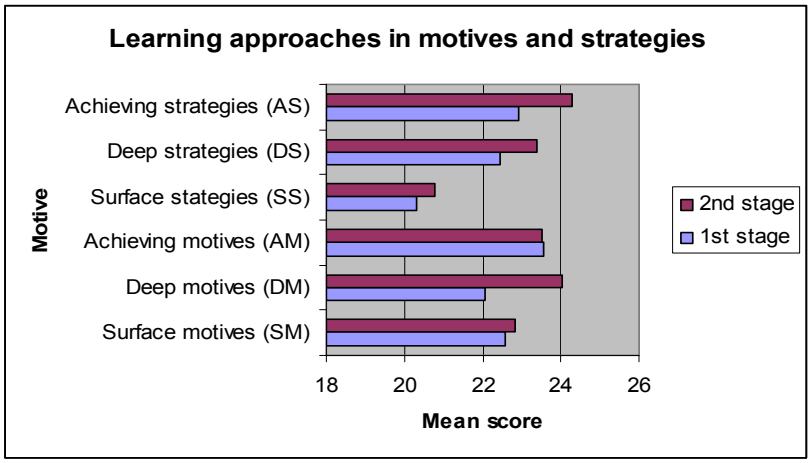

Figure 3: Learning approaches in motives and strategies

DISCUSSION

The data show that there has been a significant shift towards deep learning motives, indicating that students have increased their focus on trying to personally understand the meaning of concepts and ideas. This, coupled with an increase in the use of achieving strategies (the optimisation and organisation of time) lends support to the claim that Republic Polytechnic's unique form of PBL is leading to greater effectiveness in learning if one accepts that the definition of effective learning as being the orientation towards deep learning.

Unlike one study (Marsh 1999) which found that PBL resulted simply in an increase in achieving motive and strategy, this study found the Republic Polytechnic's form of PBL can improve both motive (deep) and strategy (achieving) which is consistent with Biggs (1987a) claim that students undertaking PBL should score higher in deep and achieving approaches and lower in surface approaches. The Republic Polytechnic emphasis on constructing problems around ideas and a daily process centred on the outcome of students developing conceptual frameworks that facilitate understanding may be significant in this shift in motive. The cycle of a one-day one problem may also be significant in students developing achieving strategies that are focussed on maximising the limited amount of time afforded to them in responding to a problem.

It has been observed elsewhere that students engaged in more conventional higher education programmes tend to move towards surface approach in learning (Biggs, 1987a; Gow, Kember 1990; Watkins & Hattie,1985). As the findings reported here are based on first-year students at the Republic Polytechnic, the question remains as to whether students will continue developing a deep approach towards learning as they progress through the final two years of study at the Polytechnic. Furthermore it is worth asking what aspects of Republic Polytechnic's educative process both facilitate or perhaps hinder this shift towards more effective learning. The authors plan to continue to track the batch of students used in this study as they proceed to their 2nd and 3rd year of academic life at the Republic Polytechnic and examine the specific impact of the various key elements of the Polytechnic's one day one problem™ educative process.

REFERENCES

REFERENCES

Biggs, John B. (1987) The Study Process Questionnaire (SPQ): Manual. Australian Council for Educational Research, Hawthorn, Victoria

Biggs, John B. (1987a) Student Approaches to Learning and Studying. Melbourne: Australian Council for Educational Research.

Biggs, John B. (1999) "What the student does: teaching for enhanced learning". Higher Education Research and Development, 18, 57-75.

Boshuizen, H. P. A., Schmidt, H. G., and Wassamer, I. (1990) Curriculum Style and the Integration of Biomedical and Clinical Knowledge. Paper presented at the Second International Symposium on Problem Based Learning, Yokyakarta, Indonesia.

De Volder, M. L., Schmidt, H. G., Moust, J. H. C., and De Grave, W. S. (1986) Problem- baaed Learning and Intrinsic Motivation. In *Achieuement and Task Motivotion,* J. H. C. van der Berchen, Th. C. M. Bergen, and E. E. I. de Bruyn, eds., 2 -32. Lisse**,** The Netherlands: Swets and Zeitlinger and Swets, North America.

Eisenstaedt**,** R. S., Barry, W. E., and Glanz, K. (1990) Problem-based Learning: Cognitive Retention and Cohort Traits of Randomly Selected Participants and Decliners. In Research in Medical Education: 1990. Proceedings of the Twenty-ninth Annual Conference, M. Brownell Anderson, compiler, pp. 11-12. Washington, D.C.: Association of American Medical Colleges.

Feynman, Richard Phillips. (1999) The pleasure of finding things out : the best short works of Richard P. Feynman / by Richard P. Feynman ; edited by Jeffrey Robbins ; foreword by Freeman Dyson. , Mass. : Perseus Pub, Cambridge.

Liu, Yongbing. (2005) Teacher-Student Talk in Singapore Chinese Language Classroom: Construction or obstruction?. Redesigning Pedagogy: Research, Policy and Practice. National Institute of Education, Singapore.

Martensen, D., Eriksson, H., and Ingelman-Sundberg, M. (1985) Medical Chemistry; Evaluation of Active and Problem-orientec'. Teaching Methods. Med. Educ. 19: 34-42.

Needham, D. R., and Begg, I. M. (1991) Problem- oriented Training Promotes Spontaneous Analogical Transfer. Memory Oriented Training Promotes Memory for Training. Mem. Cognit. 18: 543-557.

O'Grady, Glen. & Dr Alwis, W.A.M. (2002) One Day, One Problem: PBL at Republic Polytechnic. 4th Asia Pacific Conference in PBL. Thailand.

Patel, V. L., Groen, G. J., and Norman, G. R. (1991) Effects of Conventional and Problem-based Medical Curricula on Problem Solving. Acad. *Med.* 663: 80-389.

Watkins, Chris., Carnell, Eileen., Lodge, Caroline., Wagner, Patsy., and Whalley, Caroline. (2002) Effective Learning in NSIN Research Matters Series Editor: Frank McNeil. The University of London, Institute of Education, (downloaded March 2006) http://k1.ioe.ac.uk/iseic/research.pdf

Wun, Y.T., Chan, C.S.Y. and Dickinson, J.A. (1999) Does short-term problem-based learning change students' learning styles and preferences? In J. Marsh (Ed.) Implementing Problem Based Learning Project: Proceedings of the First Asia Pacific Conference on Problem Based Learning (pp.87-94). Hong Kong: The University Grants Committee of Hong Kong, Teaching Development Project on Enhancing Health Science Education through Problem Based Learning.

Yeo, Shu Mei .& Zhu, Yan. (2005) Higher Order Thinking in Singapore Mathematics Classrooms. Redesigning Pedagogy: Research, Policy and Practice. National Institute of Education, Singapore.

APPENDIX A - Biggs Study Process Questionnaire

No.	Statement	Revised Statements	SM	DM	AM	SS	DS	AS
1.	I chose my present courses largely with a view to the job situation when I graduate rather than out of their intrinsic interest to me.	1. I chose my present diploma largely with a view to the job situation when I graduate rather than what I genuinely prefer.	✔					
2.	I find that at times studying gives me a feeling of deep personal satisfaction.	2. I find that at times learning gives me a feeling of deep personal satisfaction.		✔				
3.	I want top grades in most or all of my courses so that I will be able to select from among the best positions available when I graduate.	3. I want top grades in most or all of my courses so that I will be able to select from among the best job positions available when I graduate.			✔			
4.	I think browsing around is a waste of time, so I only study seriously what's given out in class or in the course outlines.	4. I think browsing around is a waste of time, so I only acquire information from the resources given out in class.				✔		
5.	While I am studying, I often think of real life situations to which the material that I am learning would be useful.	5. While I am studying, I often think of real life situations to which the material that I am learning would be useful.					✔	
6.	I summarize suggested readings and include these as part of my notes on a topic.	6. I summarize the materials from the resources given out in class and include these as part of my notes when solving a problem.						✔
7.	I am discouraged by a poor mark on a test and worry about how I will do on the next test.	7. I am discouraged by a poor grade on an Understanding Test (UT) and worry about how I will do on the next UT.	✔					
8.	While I realize that truth is forever changing as knowledge is increasing, I feel compelled to discover what appears to me to be the truth at this time.	8. While I am aware that knowledge is never static, I seek to find out what is true at the present time.		✔				
9.	I have a strong desire to excel in all my studies.	9. I have a strong desire to excel in my daily grades and UTs.			✔			
10.	I learn some things by rote, going over and over them until I know them by heart.	10. I learn some things by memorising, going over and over them until I know them by heart even if I do not understand them.				✔		
11.	In reading new material I often find that I'm continually reminded of material I already know and see the latter in a new light.	11. In reading new material I often find that I will try to personalising the task, making it meaningful to my own experience and to the real world.					✔	
12.	I try to work consistently throughout the term and review regularly when the exams are close.	12. I try to work consistently every day in class and review my learning achievements regulary in preparation for Understanding Tests (UT).						✔
13.	Whether I like it or not, I can see that further education is for me a good way to get a well-paid or secure job.	13. Whether I like it or not, I can see that further education is for me a good way to get a well-paid or secure job.	✔					
14.	I feel that virtually any topic can be highly interesting once I get into it.	14. I feel that virtually any problem can be highly interesting once I get involved it.		✔				
15.	I would see myself basically as an ambitious person and want to get to the top, whatever I do.	15. I would see myself basically as an ambitious person and want to achieve top grades/position, whatever I do.			✔			
16.	I tend to choose subjects with a lot of factual content rather than theoretical kinds of subjects.	16. I tend to choose subjects that provide me with knowledge about the world around me, rather than those which deal with principles and abstract ideas.				✔		
17.	I find that I have to do enough work on a topic so that I can form my own point of view before I am satisfied.	17. I am willing to spend significant amount of time personalising the task, making it meaningful to my own experience. By doing so, I gained a deep sense of personal satisfaction.					✔	
18.	I try to do all of my assignments as soon as possible after they are given out.	18. I try to complete my given tasks as soon as possible after they are given out.						✔
19.	Even when I have studied hard for a test, I worry that I may not be able to do well in it.	19. Even when I have studied hard for an Understanding Test, I worry that I may not be able to do well in it.	✔					
20.	I find that studying academic topics can at times be as exciting as a good novel or movie.	20. I find that the process of working on a problem can at times be as exciting as a good novel or movie.		✔				
21.	If it came to the point, I would be prepared to sacrifice immediate popularity with my fellow students for success in my studies and subsequent career.	21. If it came to the point, I would be prepared to sacrifice immediate popularity with my fellow students for success in my studies and subsequent career.			✔			
22.	I generally restrict my study to what is specifically set as I think it is unnecessary to do anything extra.	22. I generally restrict my problem solving to what is specifically set as I think it is unnecessary to do anything extra.				✔		
23.	I try to relate what I have learned in one subject to that in another.	23. I try to relate what I have learned in one class to that in another.					✔	
24.	After a lecture or lab I reread my notes to make sure they are legible and that I understand them.	24. After the 6th Presentation, I will listen attentively and make sure that I understand all the points stated in the presentation.						✔
25.	Lecturers shouldn't expect students to spend significant amounts of time studying material everyone knows won't be examined.	25. I believe that I should not spend significant amount of time personalising the task, making it meaningful to my own experience and to the real world.	✔					

No.	Statement	Revised Statements	SM	DM	AM	SS	DS	AS
26.	I usually become increasingly absorbed in my work the more I do.	26. I usually become increasingly absorbed in solving a problem the more I get engaged in it.		✔				
27.	One of the most important considerations in choosing a course is whether or not I will be able to get top marks in it.	27. One of the most important considerations in choosing a diploma is whether or not I will be able to get top marks in it.			✔			
28.	I learn best from lecturers who work from carefully prepared notes and outline major points neatly on the blackboard.	28. I learn best from facilitator who highlight the major points clearly during the first two meetings.				✔		
29.	I find most new topics interesting and often spend extra time trying to obtain more information about them.	29. I find most new problems interesting and often spend extra time trying to obtain more information about them.					✔	
30.	I test myself on important topics until I understand them completely.	30. On topics that I do not understand, I take a proactive approach to ask questions and share my understanding with my peers and facilitators until I am confident with the topic.						✔
31.	I almost resent having to spend a further three or four years studying after leaving school, but feel that the end results will make it all worthwhile.	31. I almost resent having to spend a further three years in polytechnic learning after leaving secondary/high school, but feel that the end results will make it all worthwhile.	✔					
32.	I believe strongly that my main aim in life is to discover my own philosophy and belief system and to act strictly in accordance with it.	32. My main aim in education is to discover my own philosophy and belief system on which I can base my attitudes and actions.		✔				
33.	I see getting high grades as a kind of competitive game, and I play it to win.	33. I see getting high grades as a kind of competitive game, and I play it to win.			✔			
34.	I find it best to accept the statements and ideas of my lecturers and question them only under special circumstances.	34. I find it best to accept the statements and ideas from the 6th presentation shown by my facilitator and question them only under special circumstances.				✔		
35.	I spend a lot of my free time finding out more about interesting topics which have been discussed in different classes.	35. I spend a lot of my free time finding out more about interesting topics which have been discussed in different classes.					✔	
36.	I make a point of looking at most of the suggested readings that go with the lecturers.	36. I make a point of looking at most of the suggested readings in the resources that go with the problem triggers.						✔
37.	I am at college/university mainly because I feel that I will be able to obtain a better job if I have a tertiary qualification.	37. I am at polytechnic mainly because I feel that I will be able to obtain a better job if I have a diploma qualification.	✔					
38.	My studies have changed my views about such things as politics, my religion, and my philosophy of life.	38. What I have learned has changed my views about such things as politics, my religion, and my philosophy of life.		✔				
39.	I believe that society is based on competition and schools and universities should reflect this.	39. I believe that, since society is based on competition, schools and universities should reflect this.			✔			
40.	I am very aware that lecturers know a lot more than I do and so I concentrate on what they say is important rather than rely on my own judgment.	40. I am very aware that facilitators know a lot more than I do and so I concentrate on what they say is important rather than rely on my own judgment.				✔		
41.	I try to relate new material, as I am reading it, to what I already know on that topic.	41. I try to relate new material, as I am reading it, to what I already know on that topic.					✔	
42.	I keep neat, well-organized notes for most subjects.	42. I know where to look when I need to refer to specific notes on my subject.						✔