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## EXPERIMENTING WITH THE PROBLEM-BASED LEARNING

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# EXPERIMENTING WITH THE PROBLEM-BASED LEARNING

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## ABSTRACT

Departing from traditional approach to a new one in teaching practice is not easy. Being a new university that subscribes to even newer teaching practice results complication. The teaching staff are trained within traditional teaching boundary, whom are relaxed by the approach for teaching that they have accustomed to. The problem-based learning or PBL is not a new teaching practice. Only a few institutions of higher learning implement this approach such as the Temasek Polytechnic, Singapore; and Tromsø University College, Norway. Based on the successes of these institutions, we choose to experiment PBL into our academic settings. The respondents comprise of 50 second-year students and 53 final-year students. Using both qualitative and quantitative research methods, and making this experiment's scope only to analyzing students' feedbacks while undergoing the course, this paper explores approaches, methodology, and ways into which PBL may be implemented effectively in the future. Improved topic understanding, team-working, independent were some of the positive feedbacks on the PBL approach. On the contrary, PBL was said to be good for individual work rather than grouping and too much time was spent for every session. In addition, around 60% of respondents agree that PBL stimulates thinking more spontaneously, induces a refreshing change from the routine classroom lessons, and contributes to the depth of learning.

## Keywords

Problem-based learning, teaching practice.

## 1. INTRODUCTION

In 2006, Kolej Universiti Teknikal Kebangsaan Malaysia (KUTKM) sees the potentials of PBL. Selected faculty members registered for a three-day induction course on PBL some time in July the same year. Upon completion of the program, they would disseminate the information and knowledge to the rest of faculty members. The Faculty of Manufacturing Engineering (FKP) has five departments. Each department concentrates on a specialized field. Programs offered by the faculty conform to various standards, one of them is the ISO 9001:2000. At present, we practice outcome-based learning in our teaching, and we also expect to practice another approach to teaching that is the generic/soft skills for students along with the PBL. It can be prophesized that in the future our programs shall become hybridized education programs where the graduates are not just skillful and knowledgeable but the ability to immerse into the workforce is imminent (?).

## 2. THE PROBLEM-BASED LEARNING

In PBL courses, students work with classmates to solve complex and authentic problems that help develop content knowledge as well as problem-solving, reasoning, communication, and self-assessment skills. PBL begins with the assumption that learning is an active, integrated, and constructive process influenced by social and contextual factors. Students must learn to be conscious of what information they already know to solve the problem.

### 2.1. Group work

Group work is an essential aspect of PBL for several reasons because it helps develop learning communities in which students feel comfortable developing new ideas and raising questions about the material. It enhances communication skills and student's ability to manage group dynamics. It is interesting and motivating for students because they become actively involved in the work and are held accountable for their actions by group members. It can enhance student achievement.

The features of PBL are that the first few class meetings there exist brainstorming sessions in which issues central to the course are identified. Alternatively, instructors can create an extensive list of topics and ask students to focus on those topics that seem most interesting. The instructor develops ill-structured problems, which students work on the problems in group of three to eight students depending on the number of students in the course and the number of available instructors or tutor. Students work with their groups to solve problems during the class time as well as outside of class. Throughout each class the instructor must ensure that all students are involved in the problem-solving process and must familiarize students with the resources needed to solve problems, as well as identify common difficulties or misconceptions.

### 2.2 Assessment

PBL emphasizes depth rather than breadth of content coverage, with students having from two to six weeks to work on one problem depending on its complexity. Upon completing the research or inquiry phase of problem solving, groups may be required to write a report and present it to the rest of the class. PBL assessment should be authentic, which is to say that they should be structured so that students can display their understanding of problems and their solutions in contextually-meaningful ways. A critical part of assessment in PBL is the feedback students receive from their peers. This peer rating constituted up to ten percent of students' final grades. The

statement. The group then presents their problem statement and findings in plenary for the rest of the class that involves the tutors. A total of six presentations to the class from each group and two of the presentations should result in a written report.

PBL was introduced to the Temasek Engineering School of Temasek Polytechnic, Singapore in 1998 and entirely adopted PBL into the curricula of the Diplomas in Computing and Engineering in 1999 (Yeo, 2005). This implementation, however, has not gone full swing today due to various glitches experienced by both lecturers and students. Yeo also explains three challenges that affect students learning process. First, it is the communication between student groups as well as between student groups and lecturers. Students reported that lecturers refused to give answers to the problems posed. Some complained that they were left in the dark in the quest to find the solutions. The second is when students were directed to collaborative learning that involved sourcing of information independently and sharing the findings with the group. But students reported that the lecturer was not teaching but was expecting students to solve the problems by themselves. Lastly, students was seen as not ready to undertake PBL. They were mostly interested in learning the things that will be tested.

#### 4. OUR PRACTICED PBL

The major proportion of our PBL approach were student groupings to ease facilitation, group works to allow group activities, and peer assessment for measurement of group members' participation. At the beginning of the course students were asked to form a group of six. But some students chose to have a group of five and of two. They insisted of this group size using class politics as justification. PBL sessions were conducted mainly in tutorial and laboratory sessions. In tutorial sessions, students were usually given a topic/problem to be solved in groups. At the end of the session they were asked to present to the class and submit a short handwritten report. In laboratory sessions, students were given equipment manuals and software guidebooks where they were to explore the equipment/software with minimal guidance from the lecturer. There were no laboratory sheets given but they were to produce a short handwritten report at the end of the each session. At the conclusion of the course, prior to the final examination, students were given a chance to evaluate their group members in regard to their participation in the group activities in the whole semester. Students were assessed based on each PBL sessions participated in addition to the peer assessment. PBL marks comprised of 20% of the overall course assessment.

#### 5. EXPERIMENT METHOD

This is an exploratory research seeking answers to students' responses towards a new education approach introduced in the courses. The methods used were, generally, of two types categorized into qualitative method and quantitative method. The quantitative method was used to seek data that would enhance the reliability and validity of the qualitative data. The focus groups involved in qualitative method consists of 50 final-year students, and 53 second-year students involved in quantitative method. The question asked for the qualitative is "What do you think of the PBL approach?" As for the quantitative approach, survey used by Yeo (2005) was reproduced with alteration (see Table 1). This

survey contains 14 questions using 1 to 5 likert scale where selection 1 means "strongly disagree", 5 "strongly agree", and "undecided" for response of 3. We also observed from students indirect responses, behaviour, reaction towards PBL during the semester. This observation was recorded.

Table 1. Survey items

No.	Item
1	PBL is a suitable approach for my learning now
2	As compared to traditional teacher-centered approach, PBL is able to stimulate my thinking more spontaneously
3	PBL is a refreshing change from the routine classroom lessons
4	PBL works for almost all types of subjects
5	PBL is able to contribute to the depth of my learning
6	Age group is not a barrier in PBL
7	Personal reflection is an important element in PBL to help me discover new things about myself
8	PBL helps me to solve daily problems effectively
9	Learnners should be properly trained to handle PBL
10	PBL requires strong facilitation skills of the teachers
11	Learning from a problem is not the best way of learning
12	The power of questioning is the success factor in PBL
13	The lack of a systematic structure in a PBL setting discourages me to learn
14	It is more effective to learn as a group than to learn on my own

#### 6. RESULTS

Responses collected from qualitative approach show a few variations. Mostly noted was that student's believed PBL drove towards improved topic understanding, team-working, independent. As one student said (in exact words), "Problem-based approach is good for me, it more give understand and effective. It have relationship what the real work problem-based learning. I would like to start with basic or easy problem-based learning before go to advanced problem-based learning". We understood this statement by saying that the student did find PBL effective. He expected real life problems in PBL sessions, and he also suggested that a PBL session should start with easy-to-follow PBL sessions and proceed with a more in-depth PBL teaching style when the students have the grasp of this approach. One student pointed out that (in exact words), "So far it push student to self-study at the given time. Plus, overall students will look deeply into the purpose of studying the specific subject based on problems raised. This will enhance the students' capability to elaborate the problem given to find the solutions within teams of students. Different people have different set of minds and this contribute to broaden idea compare to individual problem solving. But PBL needs cooperation between students themselves to achieve these goals. Leadership and team members must play

instructor should also provide detailed comments about each student's strengths and weaknesses. PBL promotes students' confidence in their problem-solving skills and strives to make them self-directed learners. These skills can put PBL students at an advantage in future courses and in their careers.

### 1.3 Process

Wee (2004) suggests that the PBL process is in seven stages. Figure 1 summarizes the PBL process, while below are the stages explained in full.

- *Stage 1:* The members of the group get to know each other. It is more like icebreaking. Besides that the ground rules are set and the roles of tutor and student are defined.
- *Stage 2:* They are required to identify and clarify the problem. Next, they need to describe the problem based on the facts given.
- *Stage 3:* The students inquire possible ideas to understand or solve the problem based on the facts that they have described in Stage 2.
- *Stage 4:* The students determine what they need to learn in order to understand or solve the problem. This is where they generate learning issues and action plan.
- *Stage 5:* The students seek and summarize relevant information.
- *Stage 6:* The students conduct peer sharing information and apply relevant knowledge on the problem. The students can also develop more learning issues if they are still unclear matters. Finally, the students discuss, develop and justify solution and explanation. In this stage, the students are required to present the synthesized information that they have gathered and the solution to the problem.
- *Stage 7:* The students conduct self and group feedback on group functioning, individual problem solving process, knowledge learnt solution and tutor's facilitation.

### 3. PBL PRACTICED ELSEWHERE

Cockerill *et. al* (1996) describe the development of a module concerning the international management of change for students at Leeds Metropolitan University, United Kingdom (UK), in which this module gained accreditation at undergraduate levels. This module was aimed to enable students to combine PBL within an action research methodology using a case study. They implemented it in three phases over a semester where it began with familiarization, follows by research, and ends with dramatization. In familiarization phase, learners were introduced to the processes and methodology which highlights the distinctive inter- and multidisciplinary nature of the module. In research phase, learners were provided with a case-study simulation of an actual international business situation. Lastly, in dramatization phase, learners were formed into negotiation teams and were required to prepare for and participate in a role-play exercise.

At the Faculty of Health Sciences in Linköping University, Sweden, PBL was applied to the whole undergraduate medical as well as the other health professional education programs in 1981

(Foldevi *et. al*, 1996). The curriculum was divided into three phases. Phase I was within semester 1 to 3; phase II was within semester 4 to 5; and phase III was within semester 6 to 11. Students were exposed to human contact and regularly attended group meetings, performed video consultations, and discussed with the general practitioner and supervisor at the primary health care (PHC) centers in the region during each of terms 1 to 5. A three-week clerkship in a PHC centre in term 6, and a six-week course in community medicine in term 11. We noted that PBL practiced in Linköping University as described by Foldevi was comprehensive. In fact, PBL was first practiced in the Faculty of Health and Sciences, McMaster University, Canada to train medical students (Macklin, 2001).

At the Chinese University of Hong Kong, Walker *et. al* (1996) attempted to employ PBL in one of master's level course in educational administration. They wanted to see if their approach to PBL would produce a similar learning outcome as in Western culture. In PBL the teacher acts as a facilitator, whereas in the Chinese culture students expect everything from the teacher. In addition, it is all too common view that learning is individual rather than group activity, whereas, in PBL group work is central to its philosophy. Walker ran the program with processes such as facilitator observation where during the sessions devoted to PBL, three instructors observed and noted students groups' activities. At the conclusion of the PBL segment all students submitted a two-page account of their experience in order to observe student reflections on each session. Walker found out that students were initially lost but exhibited a high level of motivation later on during the course. Students also experienced the lack of time to complete assigned tasks but they eventually demonstrated pride and sense of accomplishment with their finished works.

Eldredge (2004) discusses PBL approach in the University of New Mexico School of Medicine, United States of America. In the PBL curriculum medical students work through one simulated patient case per week in their tutorial groups. The tutorial groups meet twice a week for about three hours per session. A group consists of about six students and one or two faculty tutor facilitators. Students have no prior reading or lectures but instead rely on collective knowledge and reasoning abilities to solve this problem. With this simulated patient, each student compiles an exhaustive list of patient's apparent and suspected problems. In addition, each student supplements this problems list with another parallel list of probable risk factors. Once completed, the group will discuss their ideas all together on the board into a collective patient problem list. Students then generate hypotheses to explain the simulated patient's condition.

According to Alvarstein (2001) PBL was introduced to Tromsø University College at the Faculty of Engineering and Economics in 1994. Its goal was to adapt project-based work into studies. In the PBL curriculum, students are divided into small group units consist of four to six students with its own tutor. Students have one project in a semester. They are required to show a good command of all learning objectives to obtain high marks. Each problem area has different time frames from two weeks to four weeks in duration. But they do not have specific literature on their syllabus but they are given a list of textbooks, articles and recommended Internet addresses. The students are also encouraged to use other sources such as academic articles, educational videos. Each group work on the same topic or problem area, but has to come up with their own problem

their role to fully take advantage of PBL". In addition, another student claimed that (in exact words), "In my opinion, problem-based learning have advantages and disadvantages in subject. Advantages: can be independent for student; get new knowledge to subject topic; get new idea to study. More assignment to do combine with other assignments".

Through observation, we saw that students did participate in class and very few students showed rejection to this approach. For the peer assessment exercise students gave high marks to their peers. It happened to be that when they were asked to formed a group, mostly among their closest colleagues. We suspected either all group members satisfactorily participated in group works or simply helping each other for good marks. But very few gave low marks to their peers.

There were around 60% of students agreed that PBL stimulates thinking more spontaneously, induces a refreshing change from the routine classroom lessons, and contributes to the depth of learning. While there was around 40% agreed that it is more effective to learn as a group. If the responses were to be added up by assuming that the responses of "agree" and "strongly agree" come under general agreement to the survey items, then all the above responses were to become around 70% (see Table 2).

**Table 2. Survey items' percent response**

Item No.	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
1	2.22	17.78	22.22	44.44	13.33
2	0.00	6.67	15.56	60.00	17.78
3	2.22	0.00	24.44	64.44	8.89
4	13.33	22.22	31.11	26.67	6.67
5	2.22	6.67	22.22	62.22	6.67
6	4.44	6.67	31.11	40.00	17.78
7	0.00	2.22	24.44	55.56	17.78
8	0.00	20.00	26.67	40.00	13.33
9	0.00	0.00	20.00	53.33	26.67
10	0.00	2.22	31.11	40.00	26.67
11	26.67	15.56	33.33	17.78	6.67
12	2.22	4.44	28.89	44.44	20.00
13	0.00	6.67	37.78	37.78	17.78
14	2.22	11.11	11.11	42.22	33.33

## 7. CONCLUSION AND SUGGESTION

Teaching a PBL course was satisfying both for the lecture and students. Indeed, there were some setbacks of this implementation due to improperly planned activities, students' and lecturer readiness to a new way of teaching and learning. We saw two items that can be improved for future implementation of PBL courses. *Preparation of the problems* for PBL sessions need to be done in advance where expected solutions/hints to the problems

are realistic. Although students are accountable to their successes, which is the philosophy behind PBL, the facilitator or lecturer should have some answers in hand to allow students to build up confidence in solving the problems. Do not let them stay "in the dark". In actual fact, lecturers facilitate students in exploration of an issue, trigger their curiosity (Yeo, 2005). *Formation of student groups* should be handled by the lecturer. A mixed students' backgrounds is suggested. The success of PBL, as said by Walker *et. al* (1996) is the focus on the collectivism of mutual trust and confidence of each individual. Based on history, students preferred to stick within their closest friends and blocked the outside contacts. This outside contacts were their own classmates. Class politics was prevalent. Because when it came to peer assessment exercise the lecturer would have no say to the marks given by them which was almost certainly high.

Besides it is almost impossible for the lecturers to progress themselves in currently rapid technological advances. In addition, it is expensive to train them regularly on specific engineering technologies. Even by doing research alone could not have lead to lecturer expertise to certain technologies. All in all, to become an expert in a field takes a very long journey. This lack of expertise arises when final students start registering for advance engineering courses and there are no people volunteering to teach them. Well, the advantage of PBL is that the lecturer involves in teaching advanced courses need not be an expert of the field but must assume a good facilitating role. With proper planning of PBL sessions, he or she should successfully handle the course.

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