PBL as Perceived by Malaysian Engineering Students

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Abstract
Teaching undergraduates at tertiary level is surely not an easy task what more when your students are engineering undergraduates who need to be competent not only in the technical and hard skills but the generic skills as well. Surveys suggest that the generic aspect demand equal if not greater emphasis in order to produce competent marketable engineering graduates. However, in Malaysia many engineering undergraduates come from an exam-oriented schooling system that lacks of ingredient to develop both the technical and generic skills. Hence, a proper teaching method should be applied at tertiary level so that the engineering students graduated from universities are competent in both technical and generic skills. In order to achieve this goal, University Tun Hussein Onn Malaysia (UTHM) has decided since 2005 to fully implement Problem-based Learning (PBL) to its engineering undergraduates. Some problems were reportedly faced by the students and the lecturers and yet, a great number of opportunities were also gained. This study is purposely conducted to identify the perception of the engineering students on the implementation of PBL. A quantitative and qualitative data from four semesters of learning has been collected and analysed. Apart from facing with some problems during their learning, finding shows that most of the engineering students are highly satisfied with the implementation of PBL. Some suggestions have been made in order to improve the implementation of PBL and to reduce the problems faced by the students. Further studies focussing particularly on the development of a proper approach for implementing PBL were also recommended in the near future.

Keywords: Problem-based learning, engineering students, UTHM, Malaysia

1. INTRODUCTION

Changes taking place at tertiary level concerning the knowledge development and current technological advancement had also brought some great impacts on the teaching and learning approaches. Hence, excellent teaching and learning becoming one of the most critical success factors that a university should focus more attention [1]. Most recent, teaching and learning process at tertiary level had been discovered to be stagnant with the over utilization of traditional lecturing approach. Knowledge, skills and values are failed to be delivered satisfactorily to the students due to the single way approach of teaching and learning which centered mostly around lecturers. Many of the public universities graduates were claimed to be passive and unable to perform their job. Failures during interview sessions surprisingly increased due to the inability of the graduates to communicate effectively and to convince the employers of their humanistic and social skills [2]. Government as well as educationists all over the country had sensed this situation and the issues have been taken into serious consideration. The Malaysian Ministry of

Higher Education for instance had requested all public universities to tackle this problem immediately through the introduction of generic skills or soft skills programs. Since then the efforts had been put into implementation accordingly [3]. One critical way to improve the generic skills of the students is to opt for a proper approach in teaching and learning called the experiential learning in which learning centered around the students rather than lecturers. Unfortunately, most of the public universities are still prone to the utilization of lecturer-centered teaching and learning approaches [4]. They are far from realizing the importance of student-centered and experiential learning approaches in order to suit the needs of the students, the current knowledge and the technological advancement [5]

2. BACKGROUND OF THE STUDY

Medical and engineering studies are two major areas in which PBL is thoroughly practiced and being implemented for many years. McMaster University in Canada for instance has been implemented the approach for more than 40 years in medicine [6]. Aalborg University in Denmark has the PBL in engineering studies for more than 20 years. In Malaysia however this approach is considerably new in terms of a total implementation among local universities. Only certain areas of studies are using this approach seriously particularly the medicine and engineering studies. As for humanities and social studies, PBL approach was rarely practiced. Nevertheless, in 2005, University Tun Hussein Onn Malaysia (UTHM) had taken a bold step by introducing this approach to both engineering and humanities subjects in order to improve the learning process among engineering students corresponded to the university's educational philosophy which stresses upon the implementation of experiential learning and student-centered approaches. A number of studies have been conducted since then [7].

PBL at UTHM was thoroughly implemented during a semester of 14 weeks. During the implementation of PBL, the students were given selected problems as triggers to start their learning process. They learn in group comprises of 5-7 members and in some cases in which a lecturer have to handle one big classroom, the students work in 14-17 members in a group [8]. More often than not, they have to go outside classroom to get more information, conducting survey and meet other people. The problems assigned to each group were definitely related to the subject's content and skills required during the process of learning. The lecturer facilitates and guides the students along the learning process. Each group is also required to conduct weekly meeting and report to the lecturer the progress of their group learning activities in form of written and verbal reports. Online discussion between lecturer and the students and among the students themselves was also conducted using Blackboard 5. Some important learning resources were also shared through Blackboard 5. The evaluation is based both on the content and the process of learning. In assessing the learning process, the skills that essentially focused are the social, moral, ethical and communication skills [9]. For the purpose of continuous improvement, the study was conducted and at the end of semester the data was collected using questionnaire and interview. This paper is intended to discuss in general some of the findings related to perception of engineering students taking part in the PBL learning process since semester 1 of 2006/2007 session. In particular, discussion will be focussed on the latest study conducted in semester 2 of 2008/2009 session.

3. FINDINGS OF 2006 – 2009 STUDIES

3.1 Findings of the Study Conducted During Semester 1 of 2006 / 2007 session

78 engineering students participated in this July-October 2006 study in which 34 (43.6%) of them are male and 44 (56.4%) are female. The likert scale of 1 – 5 is used in the questionnaire (1 = strongly disagree and 5 = strongly agree). The overall result is shown in table 1 below [8].

Perception on...	Explanation	Mean Score	Result
Overall	PBL is easy to follow, attractive, challenging, effective, interesting way to learn	4.02	**Extremely high**
Learning Motivation	PBL enhances self directed learning skill, group learning skill, increasing students' confidence in learning, increasing students' learning motivation, increasing the level of knowledge better compare to lecturing method	3.98	**High**
Communication skill	PL increases students' communication skill	4.12	**Extremely high**
Learning skill	PBL enhances self directed learning skill, group learning skill and students' confidence in learning-	3.9	**High**
Moral and Ethics	PBL increases the level of mastering values, sense of respect and admiration to themselves and others and students' ability to act wisely	4.03	**Extremely high**
Thinking skill (Creativity and innovation)	PBL increases the level of students' thinking skill and creativity	4.08	**Extremely high**

TABLE 1: Mean Score of the Students' Perception on PBL During Semester 1 06/07

The finding of this study initially shows that PBL is highly regarded by engineering students and it was seen as a powerful tool to enhance some their generic skills. This early study had also opened further new improvement in the implementation of PBL among lecturers at UTHM.

3.2 Findings of the Study Conducted During Semester 2 of 2006 / 2007 session

In this study, some 36 engineering students had been selected to be the respondents in which 13 (36.1%) of them are male and 23 (63.9%) are female. The scale used in the questionnaire of this study is between 1-6 in which 1 is agree strongly, 2 = agree moderately, 3 = agree slightly, 4 = disagree slightly, 5 = disagree moderately and 6 = disagree strongly. Four questions regarding PBL were posted to the respondents. Total responses in each question were then divided according to the number of respondents. Mean or average rating was used to identified the level of agreement or disagreement. Table 2 below shows the mean score / average rating for each item;

Statement	Mean score / average rating	Rating
PBL is an effective way to train the students to work harder.	1.56	High (between 1 – 2; agree strongly – agree moderately)
PBL enhances team working skills more than any other traditional way of learning.	1.31	High
PBL increases independent learning skill tremendously	1.33	High
The effectiveness of PBL approach in learning social problems	1.28	High

TABLE 2: Mean and Rating Score of the Students' Perception on PBL During Semester 2 06/07

The finding shows that PBL is an effective way to train the students to work harder. The item suggests that PBL in this course required more effort on the students' part than other methods of learning. The result shows the mean score / average rating of 1.56. PBL was also seen as a powerful tool to enhance team working skills better than traditional way of learning. The result of the survey shows the mean score / average rating of 1.31. As students were actively involved in the process of learning, they had realised that their independent learning skill had increases tremendously. The item regarding this question shows the mean score / average rating of 1.33. Finally, the survey asked the students to give their opinion on the effectiveness of PBL approach in learning social problems. The result of the survey on item 5 shows the mean score / average rating of 1.28. Overall, then, students' responses to this survey showed a positive perception of PBL functioned within the course and of the benefits students and other parties derived from the introduction of PBL in overall learning process [10].

At the end of their project, the students are required to list some of the learning outcomes generated during their course of conducting the project based on PBL approach. Qualitative content analysis method has been used to identify some of the humanistic skills gained. Table 3 below listed the humanistic skills identified and the comments related to the skills mentioned [11];

Humanistic Skills Gained	Selected Comment
Understanding other people	"Incredible!!...challenging the mind, intellects, patient and challenging us to understand more about the meaning of life".
Life Long Learning Skill	"Based on my experience this project has given me more knowledge and experience on how to conduct social research. It makes me think and look forward and encouraging me to do more research."
Communication Skill	"This method (PBL) has given me many new and interesting experiences. It develops students' communication skills."
Moral and Professional Ethics	"I have experienced many things during project implementation. It was priceless. I have learned to be more tolerant and patient."
Problem Solving Skill	"Based on my experience, our project is very interesting because the group members have to use their own initiative in order to solve the problems. "
Team working skills	"Project implemented in a group is also contributed a lot more knowledge about the important of cooperation and coordination in carrying out the duty."

TABLE 3: Students' Comments and Humanistic Skills Identified

The students however have faced with few problems during their learning session. They felt that the approach has pushed their commitment to the limit. The burden is said to be increased especially in terms of the assignments and tasks. Fortunately, this has brought the students to realize that they have learnt more compare to the traditional lecturing approach. They have also learnt how to make early preparation and properly plan their learning activities. Generally, the findings show that PBL has positively changed and increased the effectiveness of students' learning activities. Learning has been successfully transformed from "rote learning" to "meaningful learning" [12].

3.3 Findings of the Study Conducted During Semester 1 of 2008 / 2009 session

140 engineering students participated in the study conducted during semester 1 of 2008/2009 sesion in which 75 (53.6%) of them are male and 65 (46.4%) are female. The likert scale of 1 – 5 is used in the questionnaire in which 1 is "strongly disagree" and 5 is "strongly agree". The overall result is shown in table 4 below [13].

Perception on...	Statement	Mean score	Result
Overall:	PBL is easy to follow, attractive, challenging, effective, interesting way to learn	4.2	Extremely high
Learning Motivation:	PBL enhances self directed learning skill, group learning skill, increasing students' confidence in learning, increasing students' learning motivation, increasing the level of knowledge better compare to lecturing method	4.19	Extremely high
Communication skill:	PBL increases students' communication skill	4.29	Extremely high
Learning skill:	PBL enhances self directed learning skill, group learning skill and students' confidence in learning	4.07	Extremely high
Moral and Professional Ethics:	PBL increases the level of mastering values, sense of respect and admiration to themselves and others and students' ability to act wisely	4.25	Extremely high
Thinking skill (Creativity and innovation):	PBL increases the level of students' thinking skill and creativity	4.27	Extremely high
Information management skill:	PBL increases students' information management skills	4.28	Extremely high
Life long learning skill:	PBL increases students' learning skills	4.29	Extremely high
Management skill:	PBL increases students' management skills	4.25	Extremely high
Problem solving skill:	PBL increases students' problem solving skills	4.21	Extremely high
Team working skill:	PBL increases students' team working skills	4.34	Extremely high

TABLE 4: Mean Score of the Students' Perception on PBL During Semester 1 08/09

The finding of this study pointed to the increasing number of generic or humanistic skills generated in the students' learning process. More structured learning activities were then developed based on the intended learning outcomes of each subject and in accordance with the Humanistic Skills Guidelines of the Ministry of Higher Education Malaysia [14].

3.4 Findings of the Study Conducted During Semester 2 of 2008 / 2009 session

3.4.1 Objective of the study

The objective of this study is to identify;
1. Engineering students' overall perception on PBL
2. Engineering students' perception on the effectiveness of PBL in developing their learning skills

3. Engineering students' perception on the effectiveness of PBL in increasing their learning motivation
4. Engineering students' perception on the effectiveness of PBL in enhancing their generic skills

3.4.2 Method Of The Study

This study is a descriptive case study research utilizing both quantitative and qualitative data. The quantitative data was collected using a set of questionnaire comprises of 25 questions. The questions were designed according to the above objectives and the research questions. While for the qualitative data, the students were asked to reflect on their learning experience at the end of the semester. The reflection was then analyzed using content analysis method. The qualitative supporting the overall findings of the study. Since this research is a case study research and focusing on the experience of a group of students involved in using PBL as their learning tool, the exclusion of any respondent would certainly jeopardize the finding. Thus, all 116 engineering students involved in learning Moral Studies in one specific class were selected to be the respondents of this study. The quantitative data collected was analyzed using Statistical Packages for Social Sciences (SPSS version 13.0). The data was reported in form of percentage and mean score. The five Likert scale was summarized into three scales of "Agree" (comprises of "Extremely Agree" [5] and "Agree" [4] scales, "Uncertain" [3] and "Disagree" (comprises of "Extremely Disagree" [1] and "Disagree" [2] scales). Mean score is based on the scores between 1 (the lowest) and 5 (the highest).

3.4.3 Data Analysis And Findings

Table 5 below shows the data on the first research question which asked, "how was the overall perception of the students about PBL after they have concluded one semester of learning?" For this research question, six questions have been asked to the respondents. The data shows that majority of the respondents or at least more than half (56.9%, mean score 3.54) agree that PBL activities are easy to follow. The same percentage also agrees that PBL attracts them to take part in the learning activities.

No.	Statement	Agree	Uncertain	Disagree	Mean	SD
1	PBL activities are easy to follow	66 (56.9%)	35 (30.2%)	15 (12.9%)	3.54	.936
2.	PBL attracts me to take part in learning activities	66 (56.9%)	31 (26.7%)	19 (16.4%)	3.51	.946
3.	PBL challenges my ability to search for new knowledge	92 (79.3%)	21 (18.1%)	3 (2.6%)	4.05	.790
4	PBL is more effective compare to the traditional lecture classroom	71 (61.2%)	29 (25.0%)	16 (13.8)	3.72	1.062
5	PBL is very interesting	66 (56.9%)	31 (26.7%)	19 (16.4%)	3.41	.995
25	I would choose PBL rather than the traditional lecture approach	73 (63.0%)	27 (23.3%)	14 (12.0%) 2 missing	3.69	.961

TABLE 5: Students' Overall Perception on PBL

More stunning fact shows that PBL challenges the students to search for new knowledge. The data recorded 79.3% of the respondent agree to this fact. Does PBL more effective compare to the traditional way of learning? Most of the respondents (61.2%) agree that PBL does more effective. PBL was also seen as an interesting new way of learning. For this fact, 56.9% respondents agreed. Although not all of the respondents were finally ready to choose PBL as their future way of learning, a quite big percentage (63.0%) are ready to choose PBL rather than

the traditional way of learning. Many of them have seen the big different brought by PBL as a student reflects, *"I found that there are big different from the primary and secondary education teaching methods which concerned more about reading on moral values. I learnt about moral studies through research and how it could be applied to the real world."*

What is the perception of the respondents on the effectiveness of PBL in developing their learning skills? Among the important learning skills focused in this study are self directed learning, group learning, mastery of cognitive, psychomotor and affective learning aspects and life long learning skill. For these skills, two most important skills generated by PBL are group learning skill (83.6%) and life long learning skill (85.3%). Based on the reflection of the students, we could possibly see how PBL has opened up opportunities for learning that has never before experienced. A first year student reflects, *"I have learnt many moral values through this method. I have never learnt through this method before, not during my school days."* Another student reflects on her learning experience, *"From this learning experience, we can say that we can learn about moral values not only from the textbooks but more importantly from other sources such as our daily life experience, environment, internet, magazines, news papers, peers and etc."* Other learning skills were also fairly developed by using PBL as shown by the data in table 6.

No.	Statement	Agree	Uncertain	Disagree	Mean	SD
6	PBL provides more opportunities to polish my self directed learning skill	76 (65.5%)	28 (24.1%)	12 (10.3%)	3.66	.924
7	PBL provides more opportunities to increase my group learning skill	97 (83.6%)	16 (13.8%)	3 (2.6%)	4.13	.741
8	PBL increases my level of knowledge more compare to lecturing method	64 (55.2%)	39 (33.6%)	12 (10.3%) 1 missing	3.66	.981
9	PBL increases my skill of understanding the subject	61 (52.6%)	38 (32.8%)	16 (13.8) 1 missing	3.55	1.002
10	PBL increases my level of mastering moral values	77 (66.4%)	30 (25.9%)	9 (7.8%)	3.80	.867
11	PBL encourages me to search for additional learning resources	99 (85.3%)	14 (12.1%)	3 (2.6%)	4.25	.768

TABLE 6: Students' Perception on the Effectiveness of PBL in developing their learning skills

What is the perception of the students on the effectiveness of PBL in increasing their learning motivation? Mix reaction was seen from the respondents on the effectiveness of PBL in increasing their learning motivation. This fact is shown in table 7 where only a slight bigger from half percentage of the respondents agreed that PBL increases their confidence and motivation in learning.

No.	Statement	Agree	Uncertain	Disagree	Mean	SD
13	PBL increases my confidence in learning	67 (57.8%)	36 (31.0%)	13 (11.2%)	3.59	.913
14	PBL increases my learning motivation	63 (54.3%)	41 (35.3%)	12 (10.4%)	3.53	.839

TABLE 7: Students' Perception on the Effectiveness of PBL in increasing their learning motivation

This might be related to the background of the subject and the condition of the student. Moral Studies is not a favourite subject to most of the engineering student and by given a slight burden would probably affected the learning motivation of the student. The mix reaction as seen on the data in table 7 is not totally due to the introduction of PBL but more towards the past experience of the students learning Moral Studies. This could be seen from the reflection of a first year student who says, *"At first, I'm really curious why even at this phase (university level) we still need to study moral. To be honest, I felt quite annoying with this. For me, no matter how much we*

learn about moral, no matter how well we memorize the moral values and definition, it is useless if we decided to become a bad person. Moral, in short is actually a guideline, not a must for us. We are free to choose whether we want to follow or not. After attending this class, I have to admit that I have learned a lot of things."

Finally, among the most important role of PBL is to develop the student's generic skills, the critical skills required not only during the study period but more importantly after the graduation and joining the work and profession. The data in table 8 shows that most of the respondents agree that PBL in many ways enhanced their generic skills. Although the creativity skill was seen as the least skill developed through PBL, other skills including communication skill, team working skill, ethical and moral skills (no. 17 and 24), problem solving skill, thinking skill, management skill, information management skill and life long learning skill show a considerably high agreement from the respondents [15]. A student from Electrical and Electronic Engineering has everything to tell us about how PBL managed to enhance his generic skills. He reflects, *"Moral studies had taught us to work efficiently in a big group. Every group member need to cooperate so that the task could be accomplished on time. Beside that, we have also improved our communication skills and problem solving skill since we have to communicate with each other and working hard to solve the problems arise in doing group work. As the task needs us to finish on time, we also develop in us the time management skill. Moreover, creativity and thinking skills were also learnt by most of the group members while participating in group discussion. Our group managed to work together because of the tolerance among each group member."*

No.	Statement	Agree	Uncertain	Disagree	Mean	SD
15	PBL increases my communication skill	91 (78.4%)	23 (19.8%)	2 (1.7%)	4.03	.733
16	PBL increases my team working skill	92 (79.3%)	19 (16.4%)	5 (4.3%)	4.10	.828
17	PBL increases the feeling of respect and admiration to my self and others	87 (75.0%)	26 (22.4%)	3 (2.6%)	4.05	.811
18	PBL increases my problem solving skill	79 (68.1%)	33 (28.4%)	4 (3.4%)	3.87	.797
19	PBL increases the level of my thinking skill	88 (75.9%)	24 (20.7%)	4 (3.4%)	3.98	.844
20	PBL increases my ability to manage and execute the given tasks	96 (82.8%)	16 (13.8%)	3 (2.6%) 1 missing	4.05	.736
21	PBL increases my creativity	71 (61.2%)	36 (31.0%)	9 (7.8%)	3.66	.833
22	PBL increases my ability to manage the information	90 (77.5%)	23 (19.8%)	2 (1.7%) 1 missing	4.05	.747
23	PBL increases my ability to search for new opportunities to learn	81 (69.8%)	27 (23.3%)	8 (6.9%)	3.83	.857
24	PBL increases my ability to act wisely	76 (65.5%)	31 (26.7%)	9 (7.8%)	3.79	.956

TABLE 8: Students' Perception on the Effectiveness of PBL in enhancing their generic skills

4. CONCLUDING COMMENTS

Findings show that PBL indeed affected the engineering students' learning process in many ways. First and foremost, the students are realizing the important of changing their perspective about learning [16]. Learning should be understood as the process where most of the responsibilities fall under the student's jurisdiction and they should take charge of their learning process. Second, as learning seen as a process, the students should also pay more attention on