Problem-Based Learning in Physics Education: A Study on Engineering Students

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Abstract - **Problem-based learning (PBL) is an educational method which students act as an active learners guided by facilitator. They learn through problem solving in small groups and reflecting on their experiences. This study aims to examine engineering students' perceptions on PBL physics in Universiti Tun Hussein Onn Malaysia, UTHM. The study was conducted on 145 engineering students taking Physics 2 subject in second semester session 2007/2008. They were divided into small groups consisting 5 members in each groups. Data was collected via students' self-reflection on written questionnaire at the end of PBL session. The findings reveal that students' obtains excellent experiences and benefits from PBL physics. It also appears that at the end of PBL session students' were successfully generates soft-skills such as self-directed learning, teamwork, leadership and good presentation skills.**

Keywords: **Problem-based learning, engineering, active learners, soft-skills.**

I. INTRODUCTION

Problem Based Learning (PBL) is an exciting alternative to traditional classroom learning. Traditional educational classroom where the teacher gives their knowledge and student receive the knowledge. Effect from that situation, one way communication of education process makes passive situation in classroom. With PBL, the teacher presents with a problem, not lectures, assignments or exercises. Since the teacher are not handed "content", learning becomes active in the sense for discover and work with content that determine to be necessary to solve the problem where lectures as facilitator or mentor for references.

Nowadays, the main factor increased numbers of graduates are unemployment is poor communication skill especially in English language, attitude and curriculum. These unemployed graduates also lack of mastery in their core especially generic skills required for the job market.

In order to produce quality graduates, lectures had recently come up with attributes to reflect its student. The quality prospect of graduates shall have are effective skills in communication, able work in one team, think out the box, problem solving and life-long learning. However, to achieve the desired outcomes of expertise in content knowledge, positive attitudes and abilities in generic skills, student-centered teaching and learning techniques, especially PBL, are highly encouraged.

Problem-based learning (PBL) was introduced by McMaster University over 25 years ago. Professor Dr. Howard Barrow from McMaster University arouses this program for their undergraduate and graduate. Nowadays, the PBL are used in a few community colleges and university as well. Many schools in the United States and Canada, and all of the Ontario schools, have introduced problem-based learning into their curricula, and there is ample evidence that students learn at least as well using a problem-based learning format as they do in a conventional curriculum.

Higher learning institutions in Malaysia are applying PBL as a part of their education process. Many papers were reported regarding the implementation of PBL by lecturers and researcher [1,2]. While Universiti Tun Hussien Onn Malaysia (UTHM), PBL was embarked in January 2005 for implementation of PBL to prepare students as future engineers and technologist with the competency in soft skills and generic skills. Whereas most PBL research were adopted from student in UTHM were reported on a range courses included engineering [3], physicS [4], management [5] and technical education [6].

This paper will report engineering student's perception on PBL physics at UTHM. Accordingly, the problem during the PBL session and suggestion for improvement may well be discussed.

II. PROBLEM-BASED LEARNING

A. What is Problem-based learning?

Problem-based learning (PBL) is a total approach to education. Problems are usually description of observable phenomena that needs to be explained [7]. PBL is both a curriculum consists of carefully selected and designed problem that demand from the learner acquisition of critical knowledge, problem solving proficiency, self-directed

learning strategies and team participation skills. According to Khairiyah [8], PBL is a teaching and learning technique that can develop the desired essential skill in engineering students. In problem-based learning, the traditional teacher and student roles change. The students assume increasing responsibility for their learning, giving them more motivation and more feelings of accomplishment, setting the pattern for them to become successful life-long learners. PBL is a student-centered education especially in higher learning institutions intentionally to equip students with the knowledge, skills and attitudes to face the demands of challenging world today. The lecturer in turn becomes resources, tutors, and evaluators, guiding the students in their problem solving efforts.

B. PBL Processes

The process of problem-based learning is summarizing graphically below (Figure 1). Randomly assigned small groups of four or five students in one group will consider a problem together guidance by lecturer. During each small group session, the student group will identify and prioritize a number of learning issues. Student independently study outside the small group to research and elaborate new information and concepts. Lecturer as a tutor, for reference or discussed.

Basically the problem solving process includes a discussion of facts – what is known about the problem, information gaps – what information are needed but known, hypotheses – a list of possible causes or explanations of the problem and learning issues – areas where learners lack knowledge.

Figure 1.0 shows the processes in PBL physics implemented to engineering students in UTHM.

1. Read the problem: Understand the situation.
2. Briefing/brainstorming session: Lecturer as facilitator or tutor gives their briefing about the topic was given.
3. Forming groups / Ground rules: Facilitator divided student into small groups. Student has given their opinion and receives feedback towards one another which is supportive and constructively critical.
4. Discussion/Investigating problem: Each group will seat together and discuss the problem. Students can searching for information from various kind resource including books, journal, notes, manual and internet.
5. Analysis and result: Students gather all information and findings from their problem solving activity to determine the result.
6. Report and presentation: Each group drafting their full report and also presentation in front of their friends and facilitator, so they can improve their communication skill.
7. Final Evaluation: The facilitator will evaluate the group's report and presentation.

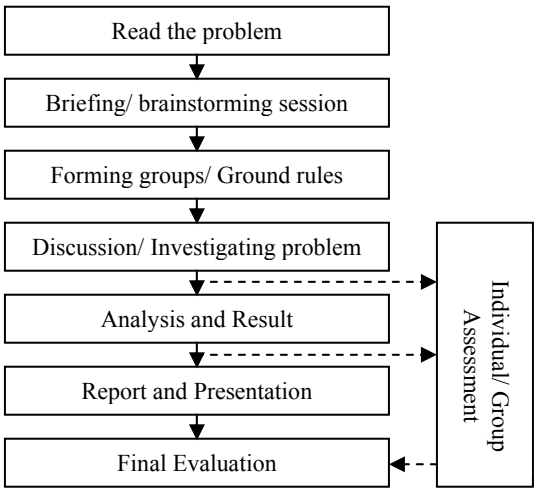

Figure 1.0 Flowchart of entire PBL process.

III. METHODOLOGY

The respondents in this study were selected at second semester session 2007/2008 and the population is 145 students were taking subject Physic 2 from undergraduate of engineering course. From the targeted population, samples were randomly selected 100 students were taken as a sample.

The instruments used to determine acquire information and student feedback on their perception of PBL. It is a quantitative approach where questionnaires were given to each student. The questionnaires were divided into six sections. Researcher uses mainly a Likert scale questionnaire. It is interpreted according to the mean score computed as shown in Table 1.0.

Table 1.0: Mean score interpretation

Mean Score	Scale Interpretation
1.00 – 2.49	Not agree
2.50 – 3.49	Fairly agree
3.50 – 5.00	Agree

IV. RESULT AND DISCUSSION

The questionnaires contain five sections consisting seven items in each section as shown in Table 2.0. The first section is about The Relevancy of Teaching and Learning (T & L) Method Using PBL in Physics Syllabus. Based on the finding, students on the whole viewed PBL positively. The outcomes from question one obtain that annotations mean 3.47 and it's shown that the students are fairly agree. They sensibility fairly agree utilizing PBL are relevancy in physic syllabus.

The respondents agree that they have basic knowledge or past experience needed in solving problems in PBL physic. Mean for this section is 3.74. In addition, facilitator had giving briefing about PBL constitute higher percentage agree on item 11 (85.5%).

However, the respondents fairly agree on question three indicate mean 2.89. They opine that the engineering students fewer basic skills or existing skill needed in solving problems in PBL Physic. It is because they come from various kind backgrounds such as polytechnic, technical school and other secondary school.

The next section inquires on the problem encountered by students during the PBL session. They were agreeing that there are some problems encountered while solving the PBL problems with mean score of 3.67. The feedbacks from students show that they need more time to solve the PBL problem, whereas some of them complaining on lack of teamwork among team members.

Finally the students were agreeing with mean score 4.10 that they get some good benefits from the PBL program. They are able to present their idea confidently with good justification, arising leadership ability, able to do self-directed learning, good communication skill and gain meaningful experiences on how to tackle and solving problems.

Table 2.0 Mean score for students' perception on PBL physics.

No	Main Topic	Mean
1.	The relevancy of Teaching and Learning (P & P) method using PBL in Physics syllabus.	3.47
2.	The engineering students know the basic knowledge or past experience needed in solving problems in PBL Physics.	3.74
3.	The engineering students have the basic skill or existing skill needed in solving problems in PBL Physics.	2.89
4.	Problems encountered by engineering students to solving assignment in PBL Physics.	3.67
5.	The benefits obtain by engineering students after accomplishing the PBL Physics.	4.10

V. CONCLUSION

In general, students were agreeing they obtain benefits from the PBL physics. This study demonstrated that students felt that using PBL increased their confidence level and their own self-directed study skills. They also felt that they could understand physic's topics in more depth and probably being more systematic in solving problem. In addition they know the basic knowledge and past experience needed in solving problems in PBL physics.

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