



**IMPLEMENTATION OF PROBLEM-BASED LEARNING
(PBL) IN FOUNDATION PHYSICS SUBJECT**



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Implementation of Problem-Based Learning (PBL) in Foundation Physics Subject

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Abstract

Foundation physics is a must to engineering students. It offers basic concept in engineering field. This paper describes PBL implementation to engineering students at Universiti Tun Hussein Onn Malaysia. They are taking electrical and electronic course for diploma program. The subject is Physics 2 offered by Centre of Science Study in second semester session 2006/2007. 24 students were divided into four groups with each groups comprises of 6 members. A physics lecturer act as a facilitator of the program. As a novice in PBL, a sub-topic of temperature and heat was selected as a trigger problem. It takes four weeks to conduct the PBL session including briefing, problem solving, presentation and assessment session. Group members play an important role in their mission to solve the problem. It was achieved by planning good group strategies as well as maintains good teamwork. Students show excellent improvement after the PBL program. They are able to work as a good team member, excellent presenter, improved interpersonal communication and critical thinking.

Keywords: problem-based learning (PBL); engineering; physics; temperature and heat; generic skill.

1. Introduction

Since decades students are trained to study base on lecture-based learning. Lecturers prepare lecture notes or module from many sources; books, journals, internet and also from research findings. Then enter a class to deliver their lectures or idea to students. Students just sit down and listen to the lectures. Sometimes they take notes and doing exercises given by lecturer. This one way communication creates a passive education and learning situation in the class. Lecturers act as an active and dominant role in the class while students as a passive learner. The assessments are based on assignments, quiz, test and final exam. In this way the students are only trained on how to answer questions. This traditional learning method resulting in less student's competent in the subject, and also the soft skill or generic skills as well.

Lecturing physics to engineering students is not an easy task. It is even more so considering that future engineers with basic engineering concept need to be more competent. The development of knowledge began to be viewed as a process which individuals must grapple with complex questions, tackle problems, conduct original investigations and filter information through their social and cultural context. They manage to learn from experience and practice ideologies to complete their mission

successfully. As these ideas converged with other contextual forces, problem based learning emerged as an innovative education and learning approach.

PBL is an approach or concept in which it is acknowledged that learners should develop metacognitive skills and thus it is expected that students use reasoning abilities to manage or solve complex problems [1]. This approach was created by Barrows and Tamblyn [2]. Using this approach students are divided into small teams and did not receive traditional lecture, instead they used a 'problem pack'. When compared to traditional approach groups, students worked in PBL format were seen to have increased motivation, problem solving and self-study skills [3].

Realizing these needs to prepare future professional engineers, in 2005, Universiti Tun Hussein Onn Malaysia (UTHM) formally embarked on a bold yet challenging journey into the world of PBL [4]. Venturing into new uncertainties territory, some lecturers at UTHM were successfully managed to conduct PBL in broad area of science and engineering. Nor Haslina Hashim reported PBL implementation on civil engineering undergraduate students [5], Afandi Ahmad reported for computer engineering undergraduates [6], Suhaimi Makminin reported for chemistry [7] and Elizabeth Anthony reported on effective communication studies [8].

This paper will describe the early PBL implementation on electrical and electronic engineering diploma students taking Physics 2 (DSF1973) offered by Centre of Science Study, UTHM. They were doing PBL in second semester session 2006/2007.

2. PBL Implementations in Foundation Physics Subject

As PBL is still new to physics lecturer whose most of them teaching foundation physics to engineering students, PBL was conducted at the end of semester. Four weeks were allocated for PBL including briefing, problem solving, presentations and assessment session. 24 students were divided into four groups comprises of 6 members. Fig. 1 shows the entire process of PBL.

2.1. Creating problem/ trigger

The issue of complexity of problem design is something that is a challenge to facilitators implementing PBL. In order to designing problem or trigger, four physics lecturer were sitting down to discuss and designing a problem. A sub-topic of temperature and heat was chosen as a trigger problem. Decision was made to use lecturer's room as a trigger problem. The students were requested to find some solutions on how to control heat transfer at lecturer's room

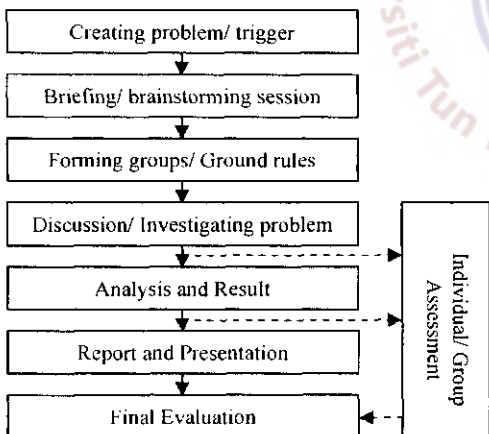


Fig. 1. Flowchart of entire PBL process.

as well as saving electricity expenditure per month. Below are the problem statement given to students.

UTHM spends hundreds of thousand RM every month for utilities purposes, especially for electrical power. As a responsible member of UTHM, we should concern how to save electricity to minimize the cost of lighting and air-conditioning.

Trigger 1 shows a typical diagram of lecturer's room. If you are maintenance officer or as an engineer, write proposals and your justification, how to overcome the problem. Among other things that you have to consider are the heat transfer through the walls and the choices of materials used as walls.

As an added trigger, diagrams of lecturer's room were given. It will help students to think and generate ideas on how to solve the problems. The diagrams of lecturer's room (Trigger 1) are shown in Fig. 2.

2.2. Briefing/ brainstorming session

Briefing session was conducted in the first week of PBL session. In this session, facilitator gives briefing on PBL to students. They includes introduction to PBL and handing the problems to each groups. The session was conducted interactively and any preliminary problems arises is discussed and solved in the class.

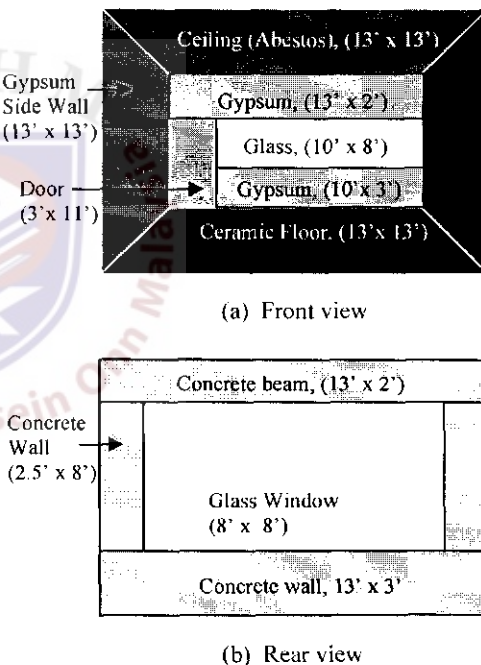


Fig. 2. Diagram of lecturer's room, Trigger 1.

2.3. Forming groups/ Ground rules

After the briefing session, the students were divided into four groups with 6 members in each group. The groups was also comprises of all races and gender. At this stage, the group will specify group's vision, mission and group outcomes for the rest PBL process. In order to ensure team commitment, team members need to work together

through a team-building activity to develop ground rules to which they all feel able to be bound and committed. Such ground rules can form the basis of a 'contact' between team members. The following are the example of group's ground rules:

- (i) Attend meeting punctually.
- (ii) Complete task given on time with good quality.
- (iii) Listen when another member is speaking.
- (iv) Speak up if there is disagreement.
- (v) Say what comes to mind.
- (vi) Give and receive feedback towards one another which is supportive and constructively critical.
- (vii) Shared responsibility for the progress of the process and outcomes of the team.

2.4. Discussion/ investigating problem

In this level each group will seat together to discuss the problem. It was starting by listing down each fact encounter from the problem statement. Any ideas related to the problem and trigger were generated and summarized by each member and noted down. Then they will discuss learning issues that can help them to solve the problem. Finally they search for information from every resource including books, journal, notes, manual and internet. All of these processes were listed in FILA table as shown in Table 1. At the same time they were practicing their generic skill during interview session with related individual or organizations.

Table 1. FILA table.

Facts	Ideas	Learning issues	Action plan
List the facts in the problem.	List as many ideas as you can generate to manage the problem.	List the topics that you need to learn in order to manage the problem.	List a plan to show how, what and where you intend to seek new information.

2.5. Analysis and result

At this stage students gather all information and findings from their problem solving activity. Analysis such as calculation and explanation on the problem findings were converged and verify to form final result. Each group will review and critique their result to determine the final solution.

2.6. Report and presentation

This is the final stage. Each group drafting their report, make conclusion and finally writing a full report. They are also trained to present in front of their friends and facilitator thus improved the communication skills.

2.7. Individual/ group assessment

During the PBL process, the students were assessed by facilitator individually and as a group. Individually the students were assessed as in Table 2. Each group members were also gave the same form to assess their friends. In group they were assessed base on teamwork, creativity, reasoning and research performance.

Table 2. Individual assessment form.

No	Assessment topics	Marks
1	Actively assisting in making group's decision	
2	Perform the task given effectively.	
3	Provide good ideas to group.	
4	Always attend meeting.	
5	Always motivates and encouraging team members.	

* 1 for lowest mark, and 5 for highest mark.

2.8. Final evaluation

In the final week, each group will present their result in front the friends and facilitator. The facifitator will evaluate the presentation as well as group's report. Individual and group's assessment during the PBL session were also considered in the evaluation session.

3. PBL Assessment and Discussion

Final result of assessment or evaluation is a proof of performance of PBL. It is an ongoing process aimed at understanding and improving student's learning. It involves in expectations, setting appropriate criteria and high standards for learning quality, systematically gathering, analyzing and interpreting evidence to determine how well performance matches those expectations and standards, and using the resulting information to document, explain and improve performance [9].

In PBL process, the students were assessed individually and as a team continuously during the session. The final evaluation will gathered all of these continuously assessment with presentation and final report. The facilitator as well the students themselves will perform the assessment based o the set criteria and standard.

During the PBL session each group will sit together in PBL class, discussing problem arises

including team problems, making short term and long term decision on how to solve the problem, take action and review the action taken. Each team member shows good cooperation to their group although there are some disagreements among them, but they were able to solve the problems. The team leader plays very important role in controlling the team members. Some soft skill such as leadership, motivation, cooperation, teamwork and critical thinking were developed during the session. Sometimes the group comes to discuss with facilitator to discuss some problems. Here they were assessed on group's commitment to ensure that all the team members participate actively in the meeting.

Besides the ongoing group's assessment, the students were also assessed individually. In this process both facilitator and students has an opportunity for assessing student's performance. Some of them successfully accomplish the standard criteria as needed in the individual assessment form. Some of them were successfully score a full mark of criteria. But a few of the students could only score a lower mark especially by their friends. This shows that there are still exists some lack of cooperation and contribution of the students to the group. However some of them shows good communication and interpersonal skills especially during interview session with lecturer, officer, staff and through telephone conversation. Overall, the students were successfully show respective value such as punctuality, highly motivated, encouraging and always do the best in their task during the PBL.

At the end of the session, the students were evaluated by facilitator on their presentation skills and report writing. The facilitator will select any team member to present their result. This will encourage each team members know what they are doing, without leaving their friends alone to complete the presentation. From the presentation session, the presentations slides were made interactively with some simple animation and picture to clearly describe their result. In addition some calculation and discussion were successfully shown to prove their result. Amazingly the students also show some new variable and method to solve the PBL problems. It shows that they were doing extra references than in the books.

The final evaluation was depends on the full report. It shows all the activity done by the team including group's meeting, minutes, FILA table, group's strategies, group's commitment and step-by-step of problem solving technique. The report was also presented in an interesting approach and clearly expresses the group's identity.

4. Problems and suggestions

Although the PBL can be assume successfully accomplish, but there are still some deficient aspect encountered during the session.

- (i) Lack of time. There are about ten topics must be covered in the second semester which temperature and heat is one of them, there are insufficient time to allocate all them in one semester.
- (ii) Costly. The expenses such as for transport, material and communication burden the students.

As a suggestion the syllabus maybe can be revised to accommodate necessary topics in PBL in one semester. If the expenses cost is very high, facilitators may be could prepare some cost effective or low cost problems. But there still some cost to sacrifice in order to accomplish a quality mission of PBL. Finally the cooperation and participation of students and facilitators are the key factor for the successful of PBL.

5. Conclusion

The problem-based learning of foundation physics was successfully implemented to electrical and electronic engineering students. From the facilitator observation generally the students were starting to understand the concept of PBL. Some soft skill or generic skills are starting to develop among the students such as leadership, interpersonal and self-directed learning skill. They are also trained to be punctual, actively generating ideas in group and good motivator to the friends.

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