FIRST EXPERIENCE IN IMPLEMENTING PBL FOR NETWORK DESIGN AND MANAGEMENT COURSE

Rafidah Md.Noor, Normazlita Hussin
Faculty of Computer Science and Information Technology, University of Malaya
50603 Kuala Lumpur, Malaysia
Email: fidah@um.edu.my

ABSTRACT

This paper described the first experience in implementing PBL for a course in Network Design and Management (WRES3308) at the Faculty of Computer Science and Information Technology (FCSIT), University of Malaya in November 2002. A total of 83 students were involved, which was divided into smaller groups of 4 to 5 students. Each group were given issues or problems that they had to understand, discuss and find solutions. The students were prompted to identify skills and knowledge that were related to the subject given. The evaluation methods used throughout the course were based on student’s presentation, student’s learning journal, participation in group discussion, final group problem report, and group’s discussion, communication, and contributions. The PBL approach was found to direct student’s learning experiences in a challenging way.

Keywords: Problem based learning, Group skills, PBL scenario; Computer science; Network design and management.

INTRODUCTION

Problem-based learning (PBL) is an innovative instructional strategy. It is a pedagogical strategy for posing significant, contextualized, real world situations, and providing resources, guidance, and instruction to students as they develop content knowledge and problem-solving skills (Mayo et. al, 1993). It is a method that encourages independent learning, gives students practice in tackling puzzling situations and help them to define their own gaps in understanding the context of relevant problems. PBL was first introduced at the Faculty of Medicine, McMaster University in Canada in the mid-1960s. It has subsequently been adopted in many different fields such as nursing, engineering, law and business but less common in Computer Science and Information Technology education.

PBL is different from the traditional instructional method. The focus in traditional instructional method is on the content. On the other hand, PBL focuses on the student and the authentic problems. The subject for a PBL activity is the group of students, rather than instructors. The student plays major roles in the activity whereas the instructor’s role is to facilitate them to the right path and to ensure that the learning objectives are achievable (Wright and Lake, 1995). The objective of the PBL activity is to provide a problem that students have to solve themselves with instructor’s guidance. PBL forces the students to learn the fundamental principles of the subject in the context of needing it to solve a problem.

The activity requires some tools to smooth out the learning process. Normally students use blackboards, computers and experimental equipments. The venue for doing this activity normally takes place in discussion rooms, library and laboratories. Some activities need
learning materials from books, Internet and other resources. PBL offers an opportunity to practice, use, and develop such processing skills as problem solving, interpersonal, group and team skills, the ability to cope with change, lifetime or self-directed learning skills and self-assessment skills. These are valued skills within themselves. Students should have "good" ability with these processing skills if they want to gain the most benefit from PBL.

In PBL, the activity comprises various forms of actions like exploring the problems, identifying the issues involved, searching for resources, interviewing experts, discussing and reasoning to generate solutions (Dolmans, Gijselaers and Schmidt, 1992). Each action is expected to end with an outcome. The outcome does not need to be a complete solution and could be a part of the solution that will be useful for further actions and discussions.

The PBL project at the Faculty of Computer Science and Information Technology (FSCIT) University of Malaya started in 2002. Only a few subjects were selected to use the PBL method. The changes introduced in the networking courses involved a deviation from the usual instructor-centred environment in the regular didactic classes. The introduction of PBL in the courses is part of the faculty’s initiative and lecturer’s effort to focus on the relevance of the courses to real life situation.

PBL required the students to assume greater responsibility for their own learning. Students were encouraged and supported in the following development of the core skills (Sharman and Wright, 1995) as listed below:

- Problem solving
- Critical thinking
- Communication
- Information gathering
- Time management
- Computing
- Teamwork.

The main consideration for the introduction of the PBL strategy, the features of the course content, the course management, student’s perceptions as well as reflections on the process, the instructor’s reflections and experiences will be discussed.

**MODULE DESCRIPTION**

The PBL method was introduced to FCSIT’s third year students in the Bachelor of Computer Science and Bachelor of Information Technology programmes. The subject was Network Design and Management (WRES3308), an elective course of 3 credit hours for non-networking students. This implicated that the students needed to be case study into the details of this course.

Changing from the normal lecture-based course delivery to a PBL system meant that some adjustments to the regular structure of the module were made. Since this was the first experiment, the instructor had to identify different levels of knowledge among her students. Not all students have the same level of understanding and skills to cooperate in the group discussion. The module description and operational details are summarised in Table 1.
Table 1: Module Description

<table>
<thead>
<tr>
<th>Module Code and Title</th>
<th>Level</th>
<th>Credit Hours</th>
<th>Number of Students</th>
<th>Mode of Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>WRES3308 Network Design and Management</td>
<td>Third year undergraduate Degree programme (Elective)</td>
<td>3</td>
<td>83</td>
<td>20% Presentation, Report and Learning Journals 5% Self Assessment 5% Peer Assessment 10% Mid Term Examination 50% Final Examination</td>
</tr>
</tbody>
</table>

The objectives of the subject were:

? To study the principles of network design
? To familiarise students with internetwork devices and technology
? To design a campus or enterprise network using the real-world scenario.

The actual time that the students spent on one PBL scenario was about 2 to 3 weeks for each sub topic or topic covered. The weekly activities for the entire course were summarised in the Table 2.

Table 2: Weekly Activities

<table>
<thead>
<tr>
<th>Week</th>
<th>Activities</th>
<th>Tools</th>
</tr>
</thead>
</table>
| Week 1 | ? Instructor introduces the basic of Problem-Based Learning  
? Students are divided into groups  
? Instructor give one example of a PBL scenario | ? Overhead Projector (OHP)  
? Power Point |
| Week 2 | ? Chapter 1: Introduction to Computer Network (Lecture)                                      | ? Overhead Projector (OHP)  
? Power Point |
| Week 3 | ? Chapter 2: Introduction to Network Design (Lecture)                                      | ? Overhead Projector (OHP)  
? Power Point |
| Week 4 | ? Chapter 3: Analysing Business and Technical Goals and Constraints  
? The first PBL scenario is given to each group (1st scenario onChapter 4: Identifying characterizing Existing Network) | ? Overhead Projector (OHP)  
? Power Point  
? PBL Scenario (Appendix A) |
| Week 5 | ? Brainstorming session to identify the problem for 1st scenario                  | PBL Group Discussion |
**METHOD AND STRUCTURE**

The delivery mode of this subject was broken down into a few lectures supplemented with tutorials that were grouped into three subtopics of the course (Table 2). A modified model of the PBL approach was implemented for only few part of the course on a trial basis. The students were introduced to the PBL process during the first class, which include the following steps: defining the problem, researching, organising data, generating alternatives and presenting the solutions.

There were 83 students registered in the class. The class was divided into 20 groups of 4 to 5 students each. In the first tutorial class, each group was given a scenario. Each group had to identify a specific problem in the scenario and present their findings to the class in the next tutorial session. After the presentation, questions were posed to the group. Some students did very well while others were still at the beginning stage.

Besides the above activity, students were asked to submit their weekly learning journals, in which they recorded their reflections on their learning and activities related to finding any
solutions to problems posed. Students were also provided with resources such as journals, articles, network diagrams, Internet articles and textbooks. With these resources, it was easier for them to discuss and find the solutions to the problems given.

**The First Session**

Students brought their learning journal for the first session. In this class, chairs were arranged in a circle for each group to ensure smooth flow of conversation among the students. This arrangement allowed eye contacts between members in the group. In the group discussion, the seating arrangement was important to encourage communication.

The instructor introduced herself and subsequently asked the students to introduce themselves to members of the group indicating their interests, background and matters that interest them. After the ice-breaking session, the instructor briefly explained the process and objectives of PBL and reviewed the evaluation process (Figure 1).

After the introduction and brief explanation, the first page of problem statements was distributed to each student and the process began when one of the students read it out aloud. Reading the scenario aloud kept the group focused. The group should have formed opinions about the problems such as what is known, what is needed, where to start and identify unfamiliar terminologies.

Before the end of each session, the members in the group were required to clarify their plan for their own learning between sessions which include the following (Willis, 2000):

1. Identify all the significant issues and settle on a list of learning tasks for the next session
2. Decide the issues to be tackled and these are divided amongst members
Objective 2: Designing Assessment Methods for PBL

PBL EVALUATION AND RESULTS

Evaluation of the PBL programme was essential in order to gauge whether the learning outcome had been properly achieved (Boud and Feletti, 1994). The Instructor assessed the preparation, organization and overall contribution of individual member of each group. Instructor evaluated students throughout the whole PBL session using the ‘Student Evaluation Form’. All students were also required to fill the ‘Instructor Evaluation Form’ to indicate their perception about the instructor’s teaching strategy. It is the responsibility of both students and instructor to give an appropriate positive or negative feedback as part of the PBL evaluation process, either individually with each student or in the small groups.

There were 83 responses from the students at the end of the semester. The positive feedback obtained from the students were that PBL improved their time management, self-learning, research skills, group work skills and communication skills. About 80% of the students said PBL was good and useful and 20% indicated that they had to cope with more work. The majority of the students (80%) commented that more time was required to solve the problem given, lack of resources and the weaker students required more direction as well as preparation. In PBL it is important to identify weaker students and to give them more encouragement and feedback so that they are not left behind.

Figure 2 shows the assessment method used. A total of 50% was allocated for the written final examination which tested their problem solving skills and another 50% was used for continuous assessment. About 80% of the final examination questions were PBL scenario and 20% were questions on the theory of the course. A total of 30% of the assessment marks was allocated to the presentations (4 presentations in total) where students presented their ideas for solving the problem. The other 10% of the assessment was allocated to the mid semester examination where the questions were PBL scenarios. Five percent of the marks was allocated for peer and self assessment each. A selection of the evaluation questions is shown in the Table 3.
Table 3: Analysis of the Questions

<table>
<thead>
<tr>
<th>Question</th>
<th>Agree</th>
<th>Disagree</th>
<th>No Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The course helped me learn how to obtain information from a variety of sources.</td>
<td>60.2%</td>
<td>39.8%</td>
<td>0%</td>
</tr>
<tr>
<td>2. I feel that I can apply the general principles I learn to other (your discipline) problems.</td>
<td>31.0%</td>
<td>69.0%</td>
<td>0%</td>
</tr>
<tr>
<td>3. I am comfortable working in groups.</td>
<td>90.4%</td>
<td>9.4%</td>
<td>0.2%</td>
</tr>
<tr>
<td>4. I benefit from the whole class wrap-up sessions after each problem.</td>
<td>90.4%</td>
<td>7.2%</td>
<td>2.4%</td>
</tr>
<tr>
<td>5. Compared to other courses in my major, I learned more than usual.</td>
<td>96.4%</td>
<td>3.6%</td>
<td>0%</td>
</tr>
<tr>
<td>6. As a result of this class, my ability to find, read and analyze information has improved.</td>
<td>88%</td>
<td>9.6%</td>
<td>2.4%</td>
</tr>
</tbody>
</table>

DISCUSSION AND CONCLUSION

Introducing PBL into the second semester for third year students meant that students were able to display enthusiastic responses and they were challenged to solve problems. It is assumed that third year students are more mature and have a reasonable level of communication and thinking skills. They are aware of their own responsibilities for learning, manages their role in groups and utilise available resources well. To understand a topic students seem to enjoy the experience of brainstorming rather than being lectured to.

The instructor found that PBL method of teaching consumed more time than planned, especially when developing student’s learning strategy and evaluating problem solving sessions. PBL was a new method of instruction to most of the instructors in FCSIT. It was ascertained that instructors needed a more structured guidelines to be better prepared in facilitating skills.

A good instructor needs to understand the overall goals, the objectives, education roles and an ability to use them in appropriate ways. An Instructor should be able to demonstrate the problem-based approach as an effective method for acquiring information and for developing the ability to think critically (Sharman and Wright, 1995).

Implementing PBL into the curriculum provides challenges to both students and the instructors (Hu et al, 2001). By giving problems from various examples could assist students to learn deeper rather than reading the information without digesting it during the lectures. Furthermore, it help students to think critically and at the same time develop their skills in doing presentation and writing reports.

REFERENCES


**Appendix A:** An example of the first PBL scenario

The Gladstone Group is working on a research paper about LANs. As the network engineer in this company you are asked to design a LAN for the University of Malaya. You need to gather information that support these requirements:

- The University of Malaya LAN is meant to serve different “workgroups” of staff members and students. This logical division will require the use of VLANs and will be a major design decision.
- Access to the Internet from any site in the campus, via the ATM technology.
- A series of servers is needed to facilitate online automations.
- This network implementation must be functional for a minimum of 7-10 years.
- A minimum of 1.0 Mbps to any host computer in the network and 100Mbps to any server host in the network is required.
- Only two routed protocols may be implemented in the network.