PBL IMPLEMENTATION: AN EXPERIENCE OF THE FACULTY OF COMPUTER SCIENCE AND INFORMATION TECHNOLOGY, UNIVERSITY OF MALAYA

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ABSTRACT

This paper describes the experiences of implementing Problem-based Learning (PBL) in the field of Computer Science and Information Technology, at the Faculty of Computer Science & Information Technology, University of Malaya. The implementation strategy that has been adopted is presented. This is followed by an analysis of the students’ and lecturers’ perception of PBL after its initial implementation.

Key words: Problem-based Learning; PBL; Students Perception; Lecturers Perception; Implementation Strategy.

PBL BACKGROUND AT THE UNIVERSITY OF MALAYA

The workplace of the 21st century requires professionals who not only have an extensive store of knowledge, but who also know how to keep that knowledge up-to-date, applying it to solve problems, and function as part of a team. To realize such experiences, the University of Malaya (UM) adapts constructivist pedagogical designs that are based on the assumption that learning is a product of both cognitive and social interactions in problem-centered environments. The term “problem-based learning” or PBL was made known on the campus of UM in the year 2001, although elements of PBL had already been introduced in the medical courses at the Medical faculty much earlier in their New Integrated Curriculum (Azila et.al., 1999). UM has embarked on a pedagogical reform in the instruction of undergraduate programs using the PBL method through the top-down approach embedded in the policy statements by the University’s top management. All of the university’s teaching staff has been required to rethink their teaching to include methods, which positively utilize strategies, and overtly recognize the students’ cognitive abilities and skills. The University Senate subsequently agreed that problem-based learning should be used in teaching some undergraduate courses. As a process of familiarization and early exposure to the technique of PBL, the University of Malaya will implement a learning method, which combines the technique of active learning, cooperative learning, experiential learning, contextual learning, constructive learning and inquiry learning. Generally, this technique is called interactive learning.

A PBL Committee was then formed at all Faculties and members went through a series of workshops and conferences organized by the University to understand the PBL approach. The committee members who underwent the training were held responsible to disseminate and share their knowledge to other colleagues at the faculty level. This paper shares the experiences at the Faculty of Computer Science and Information Technology (FCSIT) in introducing and implementing PBL in its undergraduate instructions.
THE PBL IMPLEMENTATION PLAN AT FCSIT

The implementation strategy that was formulated took into account factors such as; the total number of students (undergraduates), the total number of teaching staff and the number of lecture theaters, classrooms and tutorial rooms. The number of courses that are being offered to students was also considered. The faculty offers two undergraduate degrees with five specializations, and four Masters Degree programs. The total number of courses offered reaches 81 for undergraduate courses and 93 for postgraduate courses (Buku Panduan FCSIT 2002/2003, FCSIT Postgraduate Prospectus 2002/2003, FCSIT Web page).

The first obstacle is the large student number. FCSIT have a total of 2440 students and this brings the student-lecturer ratio of 1:44. According to a survey carried out by the Malaysian Ministry of Education (2002), on student-lecturer ratio throughout all public universities, FCSIT has the biggest ratio in the country. It has been recommended by Mayo et al (1993) that an ideal PBL tutorial group is to be made up of students between 6 –10. With the large student number, the small number of lecturers and the limited number of tutorial rooms, FCSIT has to be selective in choosing courses that can use PBL. Based on the first constraint, the strategy is to use PBL in courses, which have a small number of students registered. In FCSIT, small means 50 – 60 students. This strategy automatically addresses a part of the problem of insufficient tutorial rooms.

Inexperience is the second constraint. This was the first attempt at using PBL as an instructional approach and the lecturers are not trained to teach using PBL. The lecturers have never been taught using the PBL pedagogy and have never observed a PBL tutorial session before. FCSIT therefore organized a PBL workshop during the semester break where lecturers were given the theoretical exposure to PBL. The workshop introduced the lecturers to the historical background and growth of PBL, the advantages of the PBL pedagogy, the PBL learning cycle, how to conduct PBL tutorials and equally important, how to write PBL cases. The workshop also included hands-on sessions and PBL tutorials.

Perhaps the most serious concern with regards to PBL implementation in FCSIT is the quality of the PBL cases themselves. Rochester (2003) has stressed that the success of a PBL session, depends very much on the quality of the PBL case used. If the case is written inadequately or incorrectly, students will not be able to meet the learning objectives. FCSIT’s problems are being further exacerbated because in the field of Computer Science and Information Technology, there are not many references that indicates how a PBL case in this field looks like, unlike in the field of Medicine, Nursing and Dentistry. On the other hand, there are already many papers that can be referred to and used as guidance when developing the PBL cases such as those written by Diana et al (1997), Mennin and Waterman (1997) and Duch (2001). Table 1 shows a list of courses that uses PBL at FCSIT. Majority of the courses have no known references of PBL cases. With this realization, lecturers who planned to adopt PBL wrote their own PBL cases in advance and these cases are evaluated by other lecturers in the PBL committee. So as to help other lecturers in the future, a PBL case repository was set up. The repository contains all the PBL cases used by all lecturers who implemented PBL in their teaching. In future, other lecturers who want to write new cases can refer to the database of cases as a guide. To address the issue of insufficient sources of reference, the faculty has set up a PBL reference corner, where PBL related materials are kept.
Table 1: List of Courses Adopting the PBL Approach in FCSIT

<table>
<thead>
<tr>
<th>No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>No. of students</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>WKES3308</td>
<td>Network Design and Management</td>
<td>92</td>
</tr>
<tr>
<td>2</td>
<td>WMES3302</td>
<td>Decision Support System</td>
<td>96</td>
</tr>
<tr>
<td>3</td>
<td>WMET 2103</td>
<td>Information and Knowledge Organization</td>
<td>63</td>
</tr>
<tr>
<td>4</td>
<td>WRES3405</td>
<td>Mobile Computing</td>
<td>90</td>
</tr>
<tr>
<td>5</td>
<td>WMES2203</td>
<td>Information Resource Management</td>
<td>97</td>
</tr>
<tr>
<td>6</td>
<td>WAES3302</td>
<td>Machine Learning</td>
<td>34</td>
</tr>
<tr>
<td>7</td>
<td>WXET3403</td>
<td>Advanced Database</td>
<td>64</td>
</tr>
<tr>
<td>8</td>
<td>WKES3316</td>
<td>Methodology and Case Development System</td>
<td>78</td>
</tr>
<tr>
<td>9</td>
<td>WRES3103</td>
<td>Network Design</td>
<td>148</td>
</tr>
<tr>
<td>10</td>
<td>WMES3105</td>
<td>Statistical Application and Operational Research in Information Technology</td>
<td>50</td>
</tr>
<tr>
<td>11</td>
<td>WAES3203</td>
<td>Fuzzy Logic</td>
<td>58</td>
</tr>
<tr>
<td>12</td>
<td>WAES3303</td>
<td>Natural Languages Processing</td>
<td>67</td>
</tr>
<tr>
<td>13</td>
<td>WRES2106</td>
<td>Network Security</td>
<td>92</td>
</tr>
<tr>
<td>14</td>
<td>WAES2105</td>
<td>Intelligent Information Systems and Problem Solving</td>
<td>79</td>
</tr>
</tbody>
</table>

The subsequent implementation plan involves identifying the percentage of the courses content to be delivered using the PBL approach. See Table 2.

**STUDENTS' VIEWS OF PBL AS A LEARNING APPROACH**

PBL is profoundly different from the traditional methods of instruction. PBL application is expected to fulfill two quite distinct purposes (Engel, 1997) that are:

i. To assist students towards achieving a specific set of objectives and become capable in a set of competences (i.e. adapting to changes, making reasoned decisions in unfamiliar situations, critical thinking, adopting holistic approach, collaborating productively in groups, communication skills, self-directed learning, continual learners) that will be important to them throughout their professional life;

ii. To support the conditions that influence effective adult learning (i.e. active learning, integrated learning, cumulative learning, and learning for understanding).
Table 2: PBL Implementation Plan for FCSIT

<table>
<thead>
<tr>
<th>Stages</th>
<th>Target % of Implementation</th>
<th>Actual number of Courses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introductory Phase</td>
<td>2 Subjects</td>
<td>2</td>
</tr>
<tr>
<td>First Phase (1st Year)</td>
<td>30% of the total number of courses</td>
<td>18</td>
</tr>
<tr>
<td>Second Phase (2nd Year)</td>
<td>60% of the total number of courses</td>
<td>To be decided</td>
</tr>
<tr>
<td>Third Phase (3rd Year)</td>
<td>90% of the total number of courses</td>
<td>To be decided</td>
</tr>
<tr>
<td>Fourth Phase (4th Year)</td>
<td>100% PBL</td>
<td>To be decided</td>
</tr>
</tbody>
</table>

Students are one of the key players in PBL. They are the one who will acquire the knowledge, skills and attitude through the PBL format provided by the faculty. Regardless of the educational context, the primary role of the students is to learn and thus in the long run become an educated person in the real sense that is intellectually, emotionally and spiritually proficient.

In order to evaluate the effectiveness of the PBL method, students who took courses using PBL approach were asked to complete a questionnaire, which investigates:

- Their acceptance of PBL;
- The degree to which educational objectives were attained;
- The usefulness of facilitator and resource materials; and
- The problems they faced.

Findings on students’ perception are based on the lecturers’ observation while conducting the sessions, dialogue between lecturers and students, and through the PBL questionnaire. From the report presented by the lecturers who implemented PBL in their courses, the students indicated positive responses. Table 3 shows general comments from students who experienced PBL for the first time.
Table 3: Students’ General Comments on PBL

<table>
<thead>
<tr>
<th>Positive Comments</th>
<th>Negative Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Understand problems faced in the real world.</td>
<td>Afraid to voice out opinion / lack of confidence.</td>
</tr>
<tr>
<td>Enhanced communication skills.</td>
<td>Stressful / Time Consuming / Lots of preparation.</td>
</tr>
<tr>
<td>More participative and active in class.</td>
<td>Not sure if they are doing things right due to insufficient direction.</td>
</tr>
<tr>
<td>Train to become independent.</td>
<td>Unfamiliarity of PBL formats.</td>
</tr>
<tr>
<td>Tend to think first rather than asking questions.</td>
<td>Free rider or hitchhiker problems among passive students.</td>
</tr>
</tbody>
</table>

A closer analysis of the responses reveals the following information:

- Students’ readiness for PBL;
- Students’ reaction after going through PBL;
- Students’ perception towards PBL;
- Students’ concern regarding PBL.

(a) Students’ Readiness for PBL

In PBL, students are active information receivers and are expected to be more actively engaged in their learning process. Therefore, students' motivation, background and learning habits have to be taken into accounts before employing PBL into the classroom. With the PBL approach the responsibility of learning is placed in the hands of students, and those who are used to the structured and sequenced information presentation from the lecturer may fail to make progress in learning and resent the self-learning challenge. To overcome this resistance a special orientation program need to be given to students. The orientation program will introduce students to the PBL format and make them aware of educational reform and understand why PBL is important as a new instructional approach to learning. A simulated PBL session could also be introduced to give them a chance to experience the PBL session before actual implementation. Figure 1 shows the things they should know about PBL. Once they are aware of the details and benefits of PBL, they will be ready to accept the new format and change their perception on learning.

(b) Students’ Reaction after Going through PBL

After experiencing PBL for the first time, students seem to have mixed reactions. Some or rather the majority appreciates it as a positive experience and a few see it as a burden that has shaken their comfort zone of being spoon-fed with information and lecture notes. They still would like to learn in ways that are comfortable with less responsibility for their own learning.

(c) Students’ Perception towards PBL

From observation and informal interview with various students by lecturers, it was found that most good diligent, bright students like the PBL method while some of the weak students prefer the conventional lecture. There are however students who felt impartial about it. On the whole, the combination of PBL and lecture used in the courses seem to be quite effective.
(d) Students’ Concern Regarding PBL

Students are concerned about knowing and understanding the expectations for a high grade and the types of evaluation or assessments demanded by the course. The lecturer has to be transparent about this issue and discuss it with the students on the first day of class and reveal it in the course pro-forma. The acceptance of students on PBL depends very much on their readiness to change their learning habits, familiarity with the PBL mechanism, willingness to transform to their new role as active learners and the benefits of PBL as a teaching approach.

LECTURERS’ VIEWS OF PBL AS A TEACHING APPROACH

Out of the 18 courses identified to use PBL in the following semester, 7 courses did not use PBL as planned. This is due to the large number of students who have registered for the courses and since extra lecturers could not be found to assist in PBL tutorial sessions, the original plan was cancelled.

As a means of monitoring progress of PBL implementation in the faculty, the lecturers who used PBL in their courses were requested to submit a report of their experience. From the lecturers’ reports compiled, a summary of their perception are as follows:

- PBL implementation in a course requires a lot more planning and preparation than was initially anticipated. The PBL cases not only need to be well prepared, the accompanying learning outcomes, evaluation and tutorial guides must also be ready. They fear that the PBL cases prepared could not cover all the material that a topic is supposed to.
- Lecturers need to improve their facilitation skills so that they can guide students better. They would like to be better at prompting students to response and ask thought provoking questions.
- Tutorial rooms are very much needed. Presently, lecturers have to use existing classrooms that are too small to fit in many tutorial groups at the same time. The limited space makes it difficult for lecturers to move from one group to another.
- Lecturers are unsatisfied with the attitude of some students who did not do their self-study as preparation for their PBL tutorial sessions. Many students were found to have poor communication and interaction skills. They could not express their views and ideas very well. There are also students who feel pressured by the PBL approach because they...
have to learn on their own instead of the conventional passive learning. Clearly, students need more time for adjustment.

- Difficulty in managing many and big groups of students. Discussions can be noisy and there are some students who find it difficult to focus their attention to the topic of discussion and this also make some students feel bored. These students feel that they could not learn anything as a result of all these commotions. Lecturers feel that it is difficult for them to ascertain the overall involvement of students in PBL activities, as they have to move around from one group to another.

- Lecturers feel that the time allocated is insufficient for students to have a really thorough discussion on the learning objectives and to synthesize information gathered by a tutorial group.

The lecturers’ perception of PBL is described according to the following aspects:

- Lecturers’ readiness for PBL
- Lecturers’ reaction after using PBL as a teaching approach
- Lecturers’ perception towards PBL
- Lecturers’ concern regarding PBL

(a) Lecturers’ Readiness for PBL

Lecturers feel that one workshop is insufficient to assimilate enough understanding of the PBL approach and many feel a more intensive workshop is required to help them feel more confident at carrying out PBL activities in their courses. Several feel doubtful as to whether the cases that they have prepared are good enough to achieve the desired learning objectives. The lecturers also feel that they are inexperienced at facilitating PBL tutorials and would like to pick up more helpful tips at handling tutorial sessions and tackle unexpected situations. Lecturers indicate a need to officially formulate and adopt a more suitable and standard assessment method to evaluate students’ performance.

(b) Lecturers’ Reaction after Using PBL as a Teaching Approach

Lecturers generally feel that their experience with PBL have been very rewarding and satisfying. They see for themselves how their students discuss and work together to fulfill or meet the learning requirements. They are also disappointed at the attitude of some students who do not participate in tutorial discussions. Some are even surprised at noticing the poor level of intercommunication skills that the students have.

(c) Lecturers’ Perception Towards PBL

From the lecturer’s reports on their experiences in implementing PBL in their courses, it can be concluded that most lecturers are enthusiastic about implementing PBL and they get even more motivated by the students’ eagerness and also their colleagues’ successes. However, there are a reluctant few who feel discouraged because of the inconvenience caused by the large number of students, small and inadequate venues for PBL tutorials and the lack of trained tutors to facilitate tutorial sessions.
(d) Lecturers’ Concern Regarding PBL

Students are worried about how well they will do in their examinations. Likewise, the lecturers are also worried about how well the students will perform and how the students’ performance graph will turn out to be, once PBL is used. They are also concerned with the question of whether the students really learn/know about what they are supposed to. However the students’ performance in their examination removed all doubts.

DISCUSSION AND CONCLUSION

After observing the reactions and responses of both students and lecturers towards PBL for the first time, it can be concluded that a lot remains to be done to make PBL implementation a success. The obstacles are summarized into a three-tiered level of classification [Figure 2].

![Figure 2: Categories of PBL Success Contributors](image)

The University’s management plays a crucial role and their absolute support towards PBL implementation is immensely important. The management should heed to the request of lecturers to increase the number of tutors and also provide the necessary infrastructure such as adequate tutorial rooms and reference centers to support students’ self-studies. Another aspect, which requires immediate inspection, is the revision of the individual program structure. They should be formulated in such a way that learning via PBL is not burdensome but manageable and well balanced with other aspects of student’s life. The management should also formulate a series of training program for both the lecturers and tutors. The training programs will take care of new academic staff and cater the specialized needs from different disciplines.

At the lecturers’ level, they should be collaborating with lecturers from other universities and exchange ideas on how to make teaching with PBL a more rewarding experience. They should polish their skills on writing PBL cases and eventually build an archive of PBL cases. One way of trying to boost academicians’ interest in PBL is through journal publications and organizing conferences/seminars.

Students should be motivated to study with PBL if we can prove to them that being trained through PBL can make a difference. They must be made aware of the fact that a negative attitude towards PBL can result only in their lost.
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