

Problem-based Learning (PBL) as an Approach in the Teaching of Biochemistry of the Endocrine System at the Angeles University College of Medicine

M C A Villamor,*^{MD, MHPed}

Abstract

Introduction: Biochemistry is a basic science subject introduced in the first year of the medical curriculum. At the Angeles University College of Medicine, the approach used in teaching biochemistry has always been the conventional lecture-based strategy. This study described the factors involved in the development of modules and the use of problem-based learning (PBL) as an innovative strategy in teaching the biochemistry of the endocrine system. **Materials and Methods:** Four PBL modules consisting of clinical problems, student's and facilitator's guides and a list of learning objectives were developed and used by 68 first year medical students under the supervision of a tutor during small group tutorial sessions. A 5-point Likert scale questionnaire was employed to ascertain the perceptions of the students on the influences of the components of PBL on the learning process. **Results:** The respondents affirmed that the PBL approach motivated them to actively control the direction of their learning needs and encouraged them to acquire self-learning skills. Ninety per cent of the students found the PBL approach to have inspired them to take charge of their own learning of the biochemistry of the endocrine system. **Conclusion:** The study showed that the students found this alternative method acceptable particularly in motivating to clarify biochemical concepts that facilitated their understanding of selected endocrine problems.

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Introduction

The Angeles University College of Medicine (AUCOM) was established in 1983 with a curriculum that is conventionally teacher-centred. Biochemistry is a basic science subject introduced in the first year of the medical curriculum. It is an essential discipline that allows the learners to understand normal and disease processes at the molecular level. Its primary objective is to explain the chemical and metabolic processes behind health conditions. The knowledge, skills and attitudes mastered are indispensable competencies for subjects in higher year levels.

The learning objectives in biochemistry are achieved through the conventional approach mainly lectures (one to one 1/2 hours) supplemented by small group activities as laboratory experiments and case studies. Under this set up, many students are under the impression that their task in class is to passively absorb what the teacher says in lecture, what is in the textbook, what they experience in the laboratory and what they practice in homework.¹ This learning situation is basically teacher-centred where the

teacher or instructor is solely responsible for what the student is expected to learn. In effect, the learners maintain a passive role-recipient of information from the authority-figure and are not provided with the opportunity to learn within the context of their profession. This framework does not favour integration of basic knowledge in the clinical setting. The students seldom appreciate the relevance of biochemistry in the practice of medicine.

The Department of Biochemistry staff appreciates the need to change and recognises the importance of exposing the learners to a teaching-learning environment that allows them to integrate basic and clinical concepts as early as the first year.

The PBL approach was adopted to provide students with opportunities to learn an endocrine problem within a context similar to what they will encounter in their clinical practice. This study tried to answer the following questions:

- What are the fundamental requisites in the development of the PBL modules?
- What are the significant experiences acquired during the

* Chairman, Department of Biochemistry

Chairman, Curriculum Committee

College of Medicine, Angeles University, Angeles City, Philippines

Address for Reprints: Dr Marivic C A Villamor, Department of Biochemistry, College of Medicine, Angeles University, Angeles City, Pampanga, Philippines.

E-mail: Silvmax_99@yahoo.com

implementation of the innovative teaching strategy?

- What is the perception of the AUCOM first year medical students regarding the use of PBL as a strategy in teaching the biochemistry of the endocrine system?

PBL is an innovative approach to learning and instruction in which students tackle problems in small groups under the supervision of a tutor.² It is learning undertaken by a student in response to being confronted by a clinical or biomedical problem.³ The principle of PBL is to put learners in a particular situation, and then to give them a task or challenge as a source for learning, and arrange it to be of a kind similar to the work with which they will be confronted in their professional future.⁴ PBL provides an environment that resembles a physician's daily work since it sharpens skills of analysis, synthesis and evaluation necessary for clinical problem-solving. PBL is a method of instruction strongly influenced by cognitive psychology.⁵ PBL requires that problems be made available for the students to study. Problems are presented to help the learners develop clinical reasoning skills and to stimulate appropriate self-directed learning.⁶

Confronted by a problem, the tutorial group decides on what to do about the problem and how to tackle it. The group's task is to identify areas that may direct them to search for the biochemical mechanisms that will explain the problem.

During the group discussion and self-study, the students are tasked to seek information to enable them to explain and comprehend the problem. The information generated is therefore shared among them.

Materials and Methods

This study aimed to describe the processes involved in the preparation of PBL modules and their use in teaching the biochemistry of the endocrine system among the 68 first year medical students of the AUCOM. The study tried to ascertain the perceptions of the students on the components of the PBL as alternative approach in teaching a specific topic in biochemistry.

The entire first year population was included in the study. Starting with an initial population of 68 students, 6 tutorial groups (10 to 12 students/group) were assigned to 3 faculty members who have an average of 12 years of teaching biochemistry. Each facilitator was assigned two tutorial groups.

The same student population was asked to assess the PBL experience by acting as respondents to a 5-point Likert scale questionnaire. The questionnaire was designed to ascertain the satisfaction level of the students on the influence of the components of the PBL process on their learning of the biochemistry of the endocrine system.

The PBL modules and the questionnaires were pre-tested to a different population belonging to a second year class of the same institution. The opinion and input of selected faculty members teaching second year subjects were also gathered.

Development of the Modules

The study was divided into two phases. Phase 1 involved the development of the modules. Clinical cases that served as trigger problems were identified based on the learning objectives for the endocrine system. The staff having no prior experience in module preparation chose the cases based on the following criteria: 1) congruency of the case with the learning objectives, 2) suitability in facilitating learning, and 3) practicality to reproduce. The incidence of the problems within the community was a significant factor taken into consideration.

Each module was organised to include a clinical case that served as a trigger problem, the learning objectives and a facilitator's guide that directed the faculty in the conduct of the tutorial discussion. A similar list of learning objectives was distributed to the students at the end of a tutorial session.

Faculty training on the PBL approach was directed at re-orientation of the staff since they had previously attended college-based training seminars on the PBL method.

Organisation of the PBL Approach

The second phase comprised a 6-week implementation phase that included introduction of the students to the PBL process, actual use of the modules and evaluation. The students were briefed on a modified version of the 7-jump PBL process as described by Barrows.⁶

Six tutorial groups were organised and each group of 10 to 12 students was assigned a tutor. The tutors had the principal role of overseeing that the course of the discussion was "kept on track." Their main task, therefore, was not to teach in a lecture, but to guide and stimulate the learning process.⁷

A tutor's guide was then provided to assist the facilitators in ensuring that each group will achieve comparable learning outcomes. It was arranged that after every case, the learners were re-grouped and assigned to another tutor. This arrangement provided the opportunity for the students to work with other members of the class and another tutor.

The problems were presented in a printed form and were distributed in an unfolding manner or progressive disclosure. The problems served as triggers from which the learning issues were identified. Two or 3 other handouts were distributed as the discussion progressed and upon the learning needs of the students.

The 4 cases were discussed in a period of 4 weeks, two 4-hour sessions per week. The initial session was spent for clarification of concepts or terms, generation of hypotheses and identification of biochemical learning issues. The second meeting of another 2 to 4 hours was devoted to analysing the learning issues, supported by information gathered by the students during the self-study period.

The students were instructed to record the proceedings that will guide them in the succeeding tutorial session. Throughout the two sessions, the students were free to refer to any instructional material available to them. They were allowed to seek information outside the room if needed.

At the end of the second group interaction, a list of learning objectives were distributed to the learners. The learning objectives were identified as essential for each endocrine problem, paying particular attention to the chemistry, synthesis and degradation, mechanism of action and metabolic effects pertinent to each case.

The PBL process adopted in the project followed the following organisation as proposed by Schmidt² (Fig. 1):

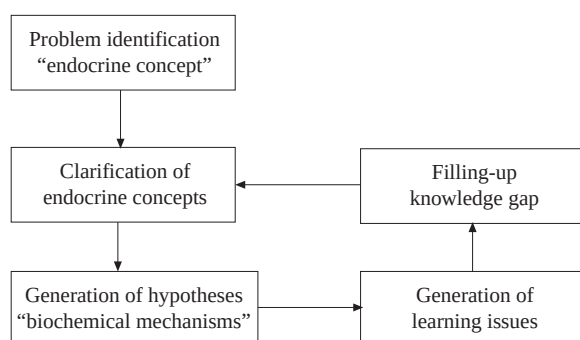


Fig. 1. The PBL process.

Result

Out of the 68 initial population, 3 dropped out and 65 answered the questionnaire. The core of PBL lies on the problems or cases that serve as trigger materials from which the discussion will evolve. The first 5 questions in the questionnaire delved into the perceived influence of the problems/cases on the student's understanding of the topic. Table I shows that 96.9% (63/65) of the students agreed that the problems were presented clearly and provided (87.7%) an opportunity for clarification of biochemical concepts (Q5). Questions 2, 3 and 4 probed on the ability of the problems to elicit self-learning skills. Sixty-one of the respondents (93.8%) overwhelmingly agreed that the problems motivated them to study by themselves and 96.9% were encouraged to look for additional information. Fifty-seven (87.7%) respondents believed that the problems

TABLE I: FREQUENCY DISTRIBUTION OF RESPONSES TO THE QUESTIONNAIRE ON THE QUALITY OF THE PBL COMPONENTS (n = 65)

	Disagree % (n)	Undecided % (n)	Agree % (n)
1. The problems were clearly stated	1.5 (1)	1.5 (1)	96.9 (63)
2. The problems sufficiently stimulated me to contribute during the SMG	3.1 (2)	9.2 (6)	87.7 (57)
3. The problems adequately encouraged me to search for more information	1.5 (1)	1.5 (1)	96.9 (63)
4. The problems motivated me to study on my own	1.5 (1)	4.6 (3)	93.8 (61)
5. The problems provided me the chance to clarify biochemical concepts	1.5 (1)	10.8 (7)	87.7 (57)
6. The working relationship among the members of the group was pleasant	6.2 (4)	9.2 (6)	84.6 (55)
7. The small group activity provided me with the opportunity to share my opinion	3.1 (2)	4.6 (3)	92.3 (60)
8. My groupmates encouraged me to articulate my thoughts	4.6 (3)	9.2 (6)	86.2 (56)
9. The small group activity allowed me to direct my learning needs	3.1 (2)	12.3 (8)	84.6 (55)
10. The other members of the group were attentive to my contributions	3.1 (2)	12.3 (8)	84.6 (55)
11. The facilitators encouraged me to share my thoughts and opinion	1.5 (1)	3.1 (2)	95.4 (62)
12. I felt at ease with the tutor during the SGD	1.5 (1)	3.1 (2)	95.4 (62)
13. The tutors encouraged every member to participate	1.5 (1)	3.1 (2)	95.4 (62)
14. The tutor allowed the group to have a healthy exchange of reasoning and opinion	1.5 (1)	3.1 (2)	95.4 (62)
15. The tutor allowed the group to direct the pace of the discussion	1.5 (1)	1.5 (1)	96.9 (63)

A: strongly agree/agree;

D: strongly disagree/disagree;

U: undecided

sufficiently stimulated them to contribute during the group discussion.

Questions 6 to 11 addressed issues pertaining to the manner by which the group dynamics fostered a pleasant and productive group interaction (Q6), encouraged the learner to contribute to the discussion (Q7) and directed his learning needs (Q9). The students' responses showed that 84.6% agreed that the tutorial session maintained a good working relationship allowing the learner to speak out his opinion, to decide his learning needs and his contributions were appreciated by the other members of the group.

The small group activity was well accepted as observed during the actual discussions. Furthermore, it encouraged within the students a sense of working within a group fostering better interaction.

In the PBL approach, the learners are the primary decision-makers in the learning process. However, the tutors play a significant role by guiding the students in their discussion. The last set of 5 questions drew out from the students their perceptions as to the contributions of the facilitators in their small group activities. The respondents agreed (96.9%) that the tutors maintained a less dominant role by allowing the group to control or set the pace of their discussion (Q15). Sixty-two respondents believed that the facilitators encouraged them individually to share their opinion (Q11). Sixty-two respondents (95.4%) established that the tutor made them feel comfortable during the interaction (Q12) resulting in a healthy exchange of information (95.4%).

Discussion

Great interest is generated by PBL as an alternative teaching approach in medical education. Numerous researches have established the effectiveness of the PBL approach and this study describes the experience of the AUCOM Department of Biochemistry in implementing PBL as a teaching approach.

The positive response of the learners to the PBL approach signifies that this strategy provides an acceptable alternative approach in teaching biochemistry. Table I reveals that the students found the PBL method satisfactory in terms of motivating them to study on their own as well as to participate actively in small group proceedings.

The general view of the PBL approach was favourable to both the students and the faculty. As in any new innovation, the experience of the Biochemistry Department was not entirely free of difficulties. At the beginning, the students were apprehensive since they had no previous exposure to such learning activity, compounded by the fact they had been used to sit and listen in a lecture. The facilitator had to exert effort to draw out contributions and to encourage the more passive students to speak out. The facilitators were tempted to take charge and give a lecture. However, as the positive attitudes of the respondents suggest the groups' openness to other methods of teaching.

Triggered by the hypothetical clinical cases, the students were able to clarify biochemical concepts pertinent to the endocrine problem being discussed. This early in their medical education, the experience provided the students the opportunity to link the biochemical principles and relate their importance to their practice in the future. This result signifies that students possess an untapped ability to

search for information that they perceive as important. What is more significant is the implication of this finding to the attitudes of the faculty towards the students. This may impress upon the faculty that the learners may be trusted to be responsible for their instructional needs and may encourage them to transfer the responsibility of learning to the students.

The data gathered demonstrate that the elements of the PBL method—modules, tutorial sessions and tutors—motivated the respondents to control their own learning as manifested by their participation in the tutorial sessions (Table I). The students exhibited cooperation and attentiveness during the tutorial meeting, initiated self-study and assumed active command of the direction of the group dynamics. These students have been so used to the traditional method that was teacher-centred and lecture-based, however, their responses denote that they are open to changes like the PBL method.

The PBL focuses on the learners, who decide on their learning goals and needs and preside over the discussion. Confronted with this task, the students rose to the challenge and assumed a more active role during the small group discussion. Through their interaction with one another, the students explored the biochemical bases of the endocrine problems.

Conclusion

This study probed into the implementation of an alternative teaching method—problem-based learning. PBL allowed the students to control their learning and to assume self-directed skills that will guide them throughout their professional career. These skills, if sustained, may transform them into life-long learners—an important quality of PBL mentioned by Neame.⁹

The study showed that the students found this alternative method acceptable particularly in motivating their learning and developing skills that will make them life-long learners. The PBL approach also gave them the opportunity to clarify biochemical concepts that facilitated their understanding of selected endocrine problems.

Application of innovative methods in teaching is a challenge that is worth looking into. A well-designed and precisely executed strategy may usher an improvement in the training of the future health provider not only in the practice of his profession but in his relationship with people around him.

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REFERENCES

1. Svinicki M D. Practical implications of cognitive theories. In: Menges, Svinicki M D, editors. *College Teaching: From Theory to Practice*. New Directions for Teaching and Learning. San Francisco: Jossey-Bass Inc Pub, 1991; 45:27-37.
 2. Schmidt H G. Foundations of problem-based learning: some explanatory notes. *Med Educ* 1993; 27:422-32.
 3. Clarke R. Problem-based learning. In: Cox and Ewan, editors. *The Med Teacher*. New York: Churchill Livingstone, 1988:48-54.
 4. Walton H J, Mathews M B. Essentials of problem-based learning. *J Med Educ* 1989; 23:542-58.
 5. Norman G R, Schmidt H. The psychological basis of problem-based learning: A review of evidence. *Acad Med* 1992; 67:557-65.
 6. Barrows H S. A taxonomy of problem-based learning methods. *Med Educ* 1986; 20:481-6.
 7. Boshuizen H D A, Snellen H A M, Grave de W S. Block design and the application of patient-cases in problem-based learning. The Netherlands: University of Limburg, Maastricht, 1990.
 8. Schmidt H G. Problem-based learning: Rationale and description. *Med Educ* 1983; 17:11-6.
 9. Neame R L B. How to construct a problem-based course. *Med Teacher* 1981; 3:113-8.
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