

An Online Evaluation of Problem-based Learning (PBL) in Chung Shan Medical University, Taiwan – A Pilot Study

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Abstract

Introduction: Problem-based learning (PBL) embraces principles of good learning and teaching. It is student-directed, fosters intrinsic motivation, promotes active learning, encourages peer teaching, involves timely feedback, and can support student self and peer assessment. The most important function of the assessment process is to enhance student learning, to improve the curriculum and to improve teaching. **Materials and Methods:** To improve the PBL tutorial in Chung Shan Medical University, we developed an online evaluation system containing the evaluation forms for students, tutor, self and peer. The Cronbach α reliability coefficients were 0.9480, 0.9103, and 0.9198 for the Student, Tutor and Self and Peer Evaluation Form, respectively. The online evaluations were mandatory to both students and tutors, and the information was completely anonymous. **Results and Conclusions:** The survey response rates of the online evaluations ranged from 95.6% to 100%. The online evaluations provided a documented feedback to the students on their knowledge, skills and attitudes. Correspondingly, tutors too received feedback from students in evaluating their performance on the appropriateness and effectiveness of tutoring the group. Although there was an initial lack of coordination regarding responsibilities and how to use the online system for both students and the Faculty, the system enabled us to look into how effective our PBL course had been, and it provided both process and outcome evaluations. Our strategy for evaluating the success of PBL is only at its initial stage; we are in an ongoing process of collecting outcome data for further analysis which will hopefully provide more constructive information to the PBL curricula.

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Introduction

The goal of problem-based learning (PBL) is to motivate students to develop self-learning skills in a small group. PBL embraces principles of good learning and teaching. It is student-centred, student-directed, fosters intrinsic motivation, promotes active learning, encourages peer teaching, involves timely feedback, and can support student self and peer assessment.¹⁻⁴ The students are encouraged to use self-directed learning skills to analyse a given clinical scenario, to identify the problems, to formulate key-learning objectives, and to collect whatever additional information they think will be needed to address those objectives. More importantly, all this takes place within a group setting, so

that each individual member of the group contributes to the learning process at every stage. At the end of each tutorial, time is set aside for the tutors to provide feedback to students and vice versa to improve the performance of both students and tutors. From the PBL tutorial, students learn to develop attitudes to facilitate cooperative PBL team work, to develop communication and group skills, to encourage peer teaching, to involve timely feedback, and to support self and peer assessment on an ongoing basis.⁵

In Asia, PBL curricula may not be easily adopted for 2 reasons: (1) Class sizes range between 100 and 250 students, requiring a large number of tutors. (2) The students are generally younger than the US cohort and have less

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experience and maturity for self-directed learning. Strong support from the academic administrators (dean and other staff responsible for implementation of the curriculum) in the introduction of PBL into the curriculum and careful training of both Faculty and students appear to be key factors to ensure the successful implementation of PBL in Asian medical schools.⁶ The PBL curricula are now widely distributed in a large proportion of Asian medical schools, although most of them are undergoing a “hybrid” PBL curriculum (“hybrid” = traditional lectures + PBL).

PBL in Chung Shan Medical University (CSMU)

PBL was introduced to CSMU in 2002. A “hybrid” curriculum which composed of approximately 20% PBL and 80% traditional lectures (dominant teaching method) was adopted. Implementation of PBL focused on clinical medicine at Year 5 class (M5, preclerk), then distributed to other organ-system based modules at Year 2, 3, 4 classes (M2, M3 and M4). These days, PBL programmes have been applied in medical ethics and basic science, and courses at Nursing School in CSMU.

PBL tutorial process was modified from the Maastricht “seven jump” process as shown in Table 1.³ A typical PBL tutorial consisted of a group of 8 students and a tutor, who facilitated the session. All tutors have been trained and certified to implement the PBL tutorial in M5 class. Students were divided into 18 small groups, 7 to 8 students in each group, 2 to 3 sessions to each tutorial and 4 to 6 PBL tutorial cases were scheduled in a semester.

The aims of the online evaluation system were (1) to provide feedback to students, tutors and administrations in improving the learning in PBL tutorial, and (2) to provide an academic research opportunity to study the effectiveness of the PBL curriculum in CSMU. Within each tutorial group, the tutor was expected to assess the students in the tutorial process, and, correspondingly, the students provided feedback to each other and to the tutor on a regular basis. The online evaluations were not intended or used to replace the immediate feedback during the PBL tutorial.

One of the most consistent findings in evaluations of PBL is a “more humane learning environment that promotes collegial interactions”. Albanese⁷ concluded that this was a worthwhile goal in and of itself. Feedback is an essential component of learning in PBL tutorial. Through feedback, individuals recognise areas of deficiency in knowledge or skills and seek to remedy these.⁸

Materials and Methods

Design of the Evaluation Forms

We designed evaluation forms for students, tutors, and student self and peer assessment (Appendixes 1 to 3). The questionnaire items (phrased in Chinese) were designed

after literature review and interviews with expert Medical Educators in National Taiwan University, National Yang-Ming University, Taipei Medical University, Fu-Jen University and CSMU. The Student Evaluation Form has 15 items representing 4 categories: (1) critical appraisal (2) utilisation of learning resources (3) group work, and (4) attitudes and communication skills (Appendix 1). The Tutor Evaluation Form has 6 items, and was evaluated by the students to assess the tutor’s performance in the PBL tutorial (Appendix 2). The Student Self and Peer Evaluation Form has 11 items (4 items for self evaluation and 7 items for peer evaluation), and was also evaluated by the students to provide peer interactions during the PBL small group tutorial (Appendix 3). Each form also has space for comments.

Validity and Reliability of the Evaluation Forms

Content experts from National Taiwan University, National Yang-Ming University, Kaohsiung Medical University and CSMU reviewed the validity of the evaluation forms. For the study, the Evaluation Forms used the Likert 5-point scale. Internal consistency and reproducibility were examined by Cronbach analysis (SPSS 13).⁹

Participants

The evaluations were mandatory for both students and tutors. All 136 students in M5 class (preclerk) during the 2005 academic year, and all 47 tutors were enrolled into the study. The tutors were all clinicians trained and certified to implement the PBL tutorial. The students were divided into 18 small groups, and the average number of students in each group was 8. Among the 18 groups, 5 of them had 2 or 3 tutors, and the remaining 13 were facilitated by a single tutor for each group throughout the semester. All participants were asked to complete the online evaluation forms within a week after the end of each case.

Online Evaluations

Each participant (students and tutors) completed the evaluation forms online at the end of each case. Information was completely anonymous and individual’s comments cannot be traced back to individual students in the website. These evaluations can be seen and checked any time by the students and the tutors of the same group to fulfill the requirement for easy accessibility and feasibility. The web site address for PBL in CSMU is <http://www.csmu.edu.tw>.

Results

Evaluation forms were completed by students and tutors after each completed case and forwarded to the PBL coordinator. The results of the evaluations were available to each tutorial group including the students and the tutors. The survey response rates ranged from 95.6% to 100%.

Validity and Reliability of the Evaluation Forms

The Cronbach α reliability coefficients were 0.9480, 0.9103, and 0.9198 for the Student, Tutor and Self and Peer Evaluation Form, respectively (Table 2). Cronbach α reliability coefficient >0.7 indicated that the evaluation forms were reliable for internal consistency.⁹

Evaluation on Student Performance

At the completion of each tutorial case, each student was awarded a *Satisfactory* (agree) or *Unsatisfactory* (disagree) grade on the domains outlined in the PBL Student Evaluation Form. The scores 5 and 4 indicated “very satisfactory” and “satisfactory”, score 3 indicated “no preference”, and the scores 1 and 2 indicated “very unsatisfactory” and “unsatisfactory”, respectively. An item rated as satisfactory was defined as more than 80% of the respondents scored ≥ 4 . Student performance was assessed primarily through participation in the PBL small group tutorial. There were 15 items in the form representing 4 subscores, critical appraisal utilisation of learning resources, group work, and attitudes/communication skills. In general, the tutors were satisfied with the students’ performance, 13 of the 15 items in the Student Evaluation Form were ranked high scores (4 and 5). However, the scores of 2 items (7 and 14) were below 4, which indicated that the students were not skillful in utilising the internet or other resources to gather information; in addition, they were also unfamiliar with the

Table 1. PBL Tutorial Process

1. “Elect” chair and scribe, and presentation of the scenario
2. Clarify terms and unknowns
3. Discuss what is known/preliminary ideas (Brainstorming)
4. Determine objectives/learning issues
5. Self-directed study
6. Share new information/knowledge and (Re) formulate
7. Reflect, feedback and evaluation

The PBL tutorial process was modified from the Maastricht “seven jump” process

Table 2. Reliability of the Evaluation Forms

Forms	Cronbach α value
Student Evaluation Form	0.9480 (15 items)
Critical appraisal	0.9098 (5 items)
Utilisation of learning resources	0.8250 (3 items)
To share with peer	0.7870 (3 items)
Humanistic attitudes and skills	0.8088 (4 items)
Tutor Evaluation Form	0.9103 (6 items)
Knowledge, attitude and skills	
Self and Peer Evaluation Form	0.9198 (11 items)

Internal consistency and reproducibility by Cronbach α analysis (SPSS 13)

use of appropriate presentation tools (e.g., PowerPoint) (Figs. 1a, 1b). However, the skills of the students in these 2 aspects revealed a tendency to improve in the following period (Fig. 1c).

Evaluation of Tutor Performance

At the completion of each case, the tutor was assessed by the same tutorial group students. The average ratings for tutor performance were high (4 and 5) in all 6 items of the form, and the satisfactory rate was over 90% (Figs. 2a, 2b). Students highly appreciate our faculty performance (including knowledge, skill and attitude) in the PBL tutorial. The results showed that the students were highly satisfied with the tutors’ facilitation during the small group tutorial regardless of whether they were expert or non-expert tutors.

Student Self and Peer Evaluation

For self-evaluation, 3 of the 4 items were ranked as satisfactory, and for peer evaluation, 6 of 7 items were ranked as satisfactory (Figs. 3a, 3b). The students were not very satisfied with their overall performance (item 8) and with regard to how systematic and well-organised the discussion was conducted (item 4). However, students felt they had improved and revealed self-confidence in the following period (Fig. 3c). In general, the students showed an attitude of autonomy, self-criticism, and an increase of self-confidence from case 1 to case 4 tutorials (Fig. 3c). They were earnest and highly cooperative in the evaluations. Moreover, the results showed that students acknowledged that PBL was a useful tool for developing strong working alliances in PBL group dynamics, and had a strong sense of identification and confidence in their ability to perform their own task.

Discussion

To improve the PBL tutorial, we developed online evaluation forms to access students, tutor, self and peer. The evaluations were done after the closing of each case session (formative assessment) and the online evaluations were mandatory for both students and tutors. The online evaluation provided a documented feedback to the students on their knowledge, skills (e.g., use of resources, problem analysis and solving, group work skills) and attitudes (e.g., independence, respect for the contribution of others, leadership, and self-reflection). In addition, tutors received feedback from students on their performance. The online evaluation system for PBL enables us to see how effective our course has been. The efficacy and reliability of the evaluation forms are useful in providing both process and outcome evaluations (Cronbach’s $\alpha > 0.9$).

In general, tutors are satisfied with the students’ performance, 13 of the 15 items in the Student Evaluation

Form were ranked high scores (4 and 5). However, the scores of two items (7 and 14) were below 4, which indicate that the students are not familiar with utilisation of the learning resources and the skills in presentation. Apparently, to enhance *e*-learning skills and to learn how to appraise the information are very important for students. However, we found that there was a parallel drop in the scores for items 7 and 14 for Case Number 3, perhaps this might be due to the time of PBL tutorial conducted near examination period. Unexpectedly, a small proportion of students could not use presentation tools (e.g., PowerPoint) effectively, and the reason might be due to the lack of enthusiasm in participating in the small group discussion. In comparison to the assessment by students themselves and the peers, the students showed an attitude of autonomy, self-criticism, and an attitude of self-confidence. They were earnest and highly cooperative in the evaluations.

To the contrary, students were highly satisfied with the tutors' performance regardless of whether they were subject-matter experts during the PBL tutorial or not. This may be attributed to the following two factors: Firstly, all of the tutors were trained and experienced. Secondly, the relationship between the students and the tutor in a small group was mutually interactive. Our results suggest that the ideal PBL tutor would function as a group facilitator rather than a subject-matter expert. In other words, the role of a tutor is to facilitate student learning rather than to convey knowledge.¹⁰ It is widely accepted that subject expertise is not an essential requirement for a PBL tutor, the use of expert or inexpert tutors does not appear to affect learning.² Caplow et al¹¹ reported that, to optimise learning in the group context, students preferred tutors who are minimally challenging and non-judgemental in their roles as knowledge experts, not directive in their roles as facilitators, and not directive in their roles as coaches or models of clinical reasoning.

A central organising principle of PBL is the use of small tutorial groups. This instructional format is comparable to the cooperative learning group method in which learners cooperate in framing problems, gathering resources and elaborating knowledge through discussion, teaching peers, evaluating information and sources, and answering questions.² The students acknowledged that PBL is a powerful tool for developing strong working alliances early in the group dynamics process. For work to progress efficiently, the group has a strong sense of identification and confidence in their ability to perform their task.

It is now recognised that acquiring skills in self-evaluation is a prerequisite for the continual learning of every doctor. The online evaluation system provides an opportunity to develop the skills and helps in facilitating appraisal of performance.⁵ In addition, the system also provides a

narrative space for participants to express their comments or suggestions, which are invaluable to improve our PBL curricula.

However, there were barriers in the implementation of the online evaluations in CSMU. There was an initial lack of coordination regarding responsibilities and how to use the online system for both students and the Faculty. After some modifications during the period, our system is becoming more accessible and feasible to the students and tutors. However, there were still a few students who failed to complete the evaluation forms in a timely manner, which may indicate a reflection of the students' professionalism.

Conclusion

In summary, our online evaluation system for PBL curriculum is valid and reliable. Although there was an initial lack of coordination regarding responsibilities and how to use the online system for both students and the Faculty, the formative online evaluation of PBL enabled us to see how effective our courses had been, and provided both process and outcome evaluations. Our strategy for evaluating the success of PBL represents only an initial stage; we are in an ongoing process of collecting outcome data for further analysis which will hopefully provide more constructive information to the PBL curricula.

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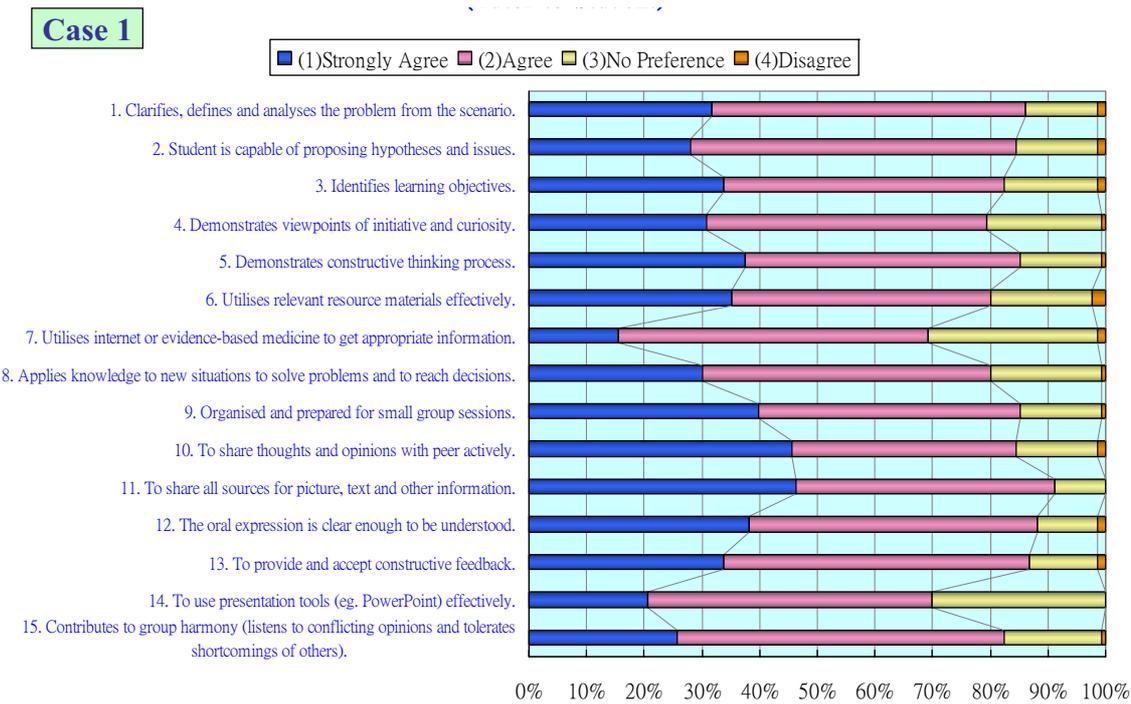


Fig. 1a.

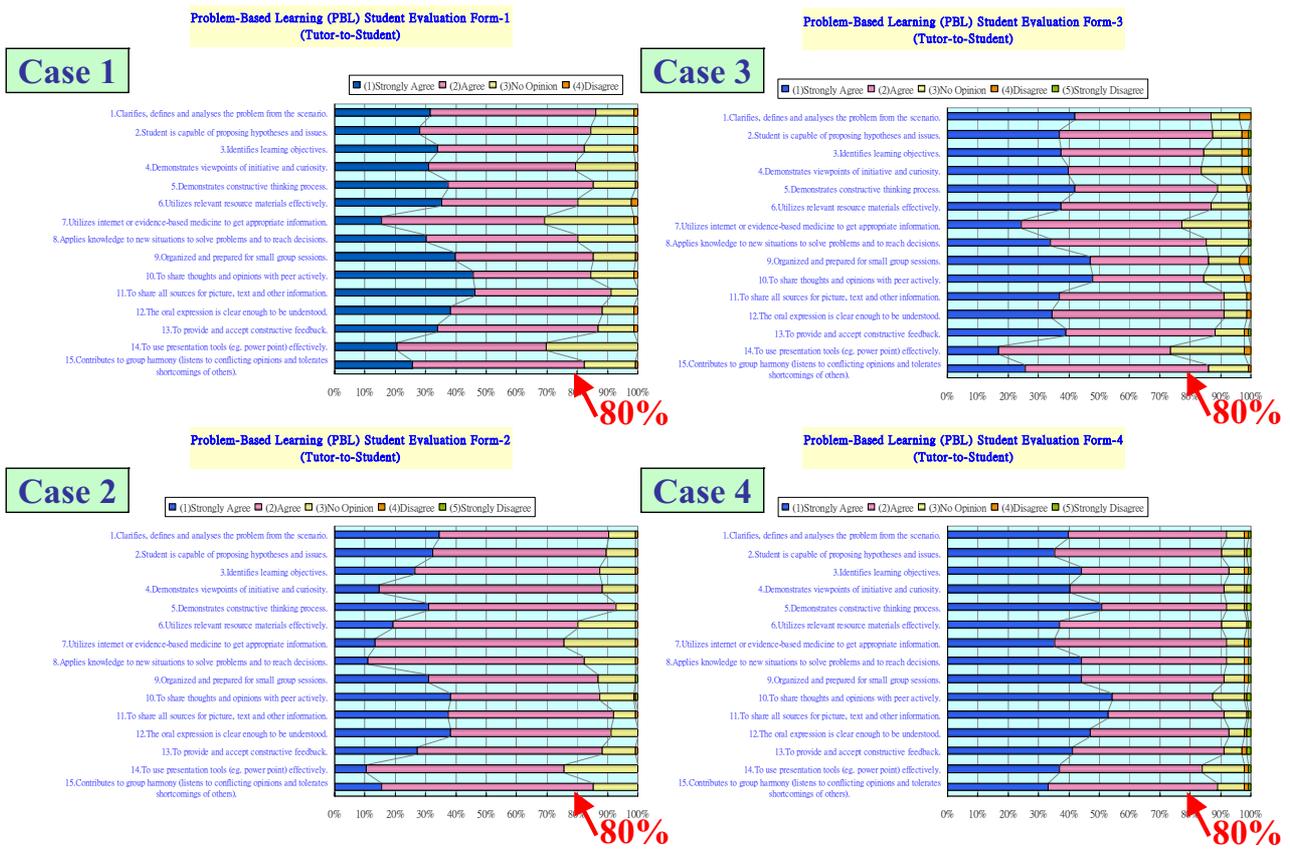


Fig. 1b.

Fig. 1. There are 15 items in the Student Evaluation Form representing 4 subscores: critical appraisal, utilisation of learning resources, group work, and attitudes/communication skills. The percentages of average scores for each item in cases 1 to 4 are shown in Figures 1a and 1b. The scores of 2 items (7 and 14) were below 4 (Fig. 1a). The skills of the students in these 2 items revealed a tendency for improvement in a following period (Fig. 1c).

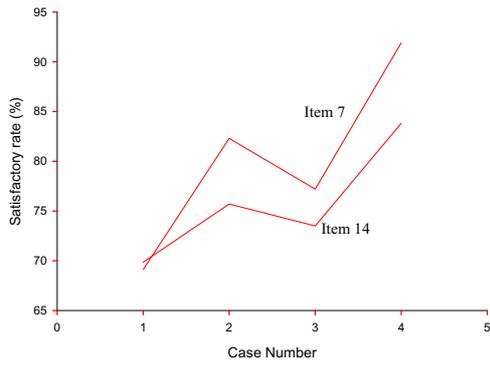


Fig. 1c.

Case 1

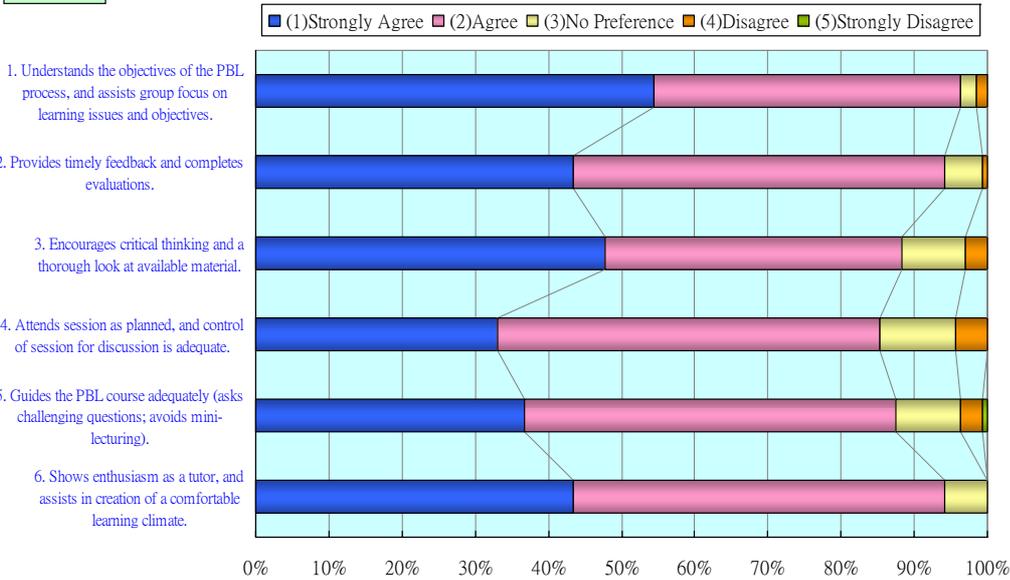


Fig. 2a.



Fig. 2b.

Fig. 2. There are 6 items in the Tutor Evaluation Form. The percentages of average scores for each item in cases 1 to 4 are shown in Figures 2a and 2b. The satisfactory rate was approximately 90% in all 6 items (Figs. 2a and 2b).

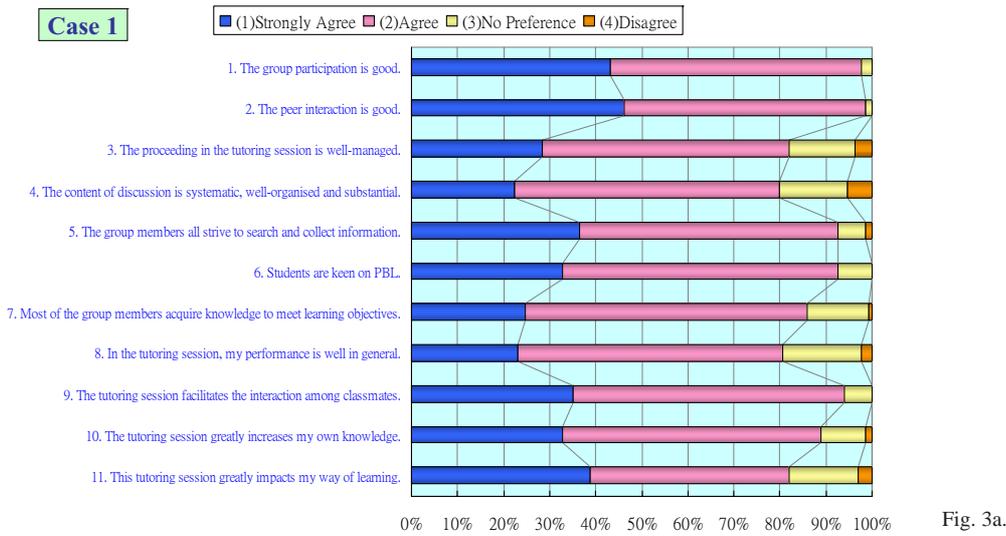


Fig. 3a.



Fig. 3b.

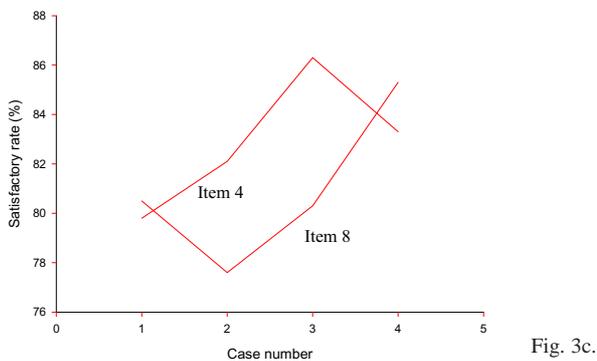


Fig. 3c.

Fig. 3. There are 11 items in the Student Self and Peer Evaluation Form. Items 1 to 7 are for peer evaluation, and items 8 to 11 are for self evaluation. The percentages of average scores for each item in cases 1 to 4 are shown in Figures 3a and 3b. The students were not very satisfied with their overall performance in a systematic and well-organised way (items 4 and 8). However, students felt they had improved and showed self-confidence in the following period (Fig. 3c).

**Appendix 1. Problem-based Learning (PBL) Student Evaluation Form
(Tutor-to-Student)**

1 = strongly agree. 2 = agree. 3 = no preference. 4 = disagree. 5 = strongly disagree.

I. Critical appraisal						
1	Clarifies, defines and analyses the problem from the scenario.					
	strongly agree	1	2	3	4	5
						strongly disagree
2	Student is capable of proposing hypotheses and issues.					
	strongly agree	1	2	3	4	5
						strongly disagree
3	Identifies learning objectives.					
	strongly agree	1	2	3	4	5
						strongly disagree
4	Demonstrates viewpoints of initiative and curiosity.					
	strongly agree	1	2	3	4	5
						strongly disagree
5	Demonstrates constructive thinking process.					
	strongly agree	1	2	3	4	5
						strongly disagree
II. Utilisation of learning resources						
6	Utilises relevant resource materials effectively.					
	strongly agree	1	2	3	4	5
						strongly disagree
7	Utilises internet or evidence-based medicine to get appropriate information.					
	strongly agree	1	2	3	4	5
						strongly disagree
8	Applies knowledge to new situations to solve problems and to reach decisions.					
	strongly agree	1	2	3	4	5
						strongly disagree
III. Group work						
9	Organised and prepared for small group sessions.					
	strongly agree	1	2	3	4	5
						strongly disagree
10	To share thoughts and opinions with peer actively.					
	strongly agree	1	2	3	4	5
						strongly disagree
11	To share all sources for picture, text and other information.					
	strongly agree	1	2	3	4	5
						strongly disagree
IV. Attitudes and Communication Skills						
12	The oral expression is clear enough to be understood.					
	strongly agree	1	2	3	4	5
						strongly disagree
13	To provide and accept constructive feedback.					
	strongly agree	1	2	3	4	5
						strongly disagree
14	To use presentation tools (eg. Power-Point) effectively.					
	strongly agree	1	2	3	4	5
						strongly disagree
15	Contributes to group harmony (listens to conflicting opinions and tolerates shortcomings of others).					
	strongly agree	1	2	3	4	5
						strongly disagree

Comment:

To describe the strengths and weaknesses of the reviewed student and to assist him/her to be a more effective learner.

**Appendix 2. Problem-based Learning (PBL) Tutor Evaluation Sheet
(Student-to-Tutor)**

1 = strongly agree. 2 = agree. 3 = no preference. 4 = disagree. 5 = strongly disagree.

No.	Item
1	Understands the objectives of the PBL process, and assists group focus on learning issues and objectives. strongly agree 1 2 3 4 5 strongly disagree
2	Provides timely feedback and completes evaluations. strongly agree 1 2 3 4 5 strongly disagree
3	Encourages critical thinking and a thorough look at available material. strongly agree 1 2 3 4 5 strongly disagree
4	Attends session as planned, and control of session for discussion is adequate. strongly agree 1 2 3 4 5 strongly disagree
5	Guides the PBL course adequately (asks challenging questions; avoids mini-lecturing). strongly agree 1 2 3 4 5 strongly disagree
6	Shows enthusiasm as a tutor, and assists in creation of a comfortable learning climate. strongly agree 1 2 3 4 5 strongly disagree
Comments: Please provide any other suggestions or comments about the tutor.	
1. What are the tutor's main strengths? What are the tutor's main shortcomings?	
2. What do you expect the tutor to do to improve in the next tutorial session?	

**Appendix 3: Problem-based Learning (PBL) Evaluation Sheet
(Student Self and Peer Evaluation)**

1 = strongly agree. 2 = agree. 3 = no preference. 4 = disagree. 5 = strongly disagree.

No.	Item						
1	Group participation is good. strongly agree	1	2	3	4	5	strongly disagree
2	Peer interaction is good. strongly agree	1	2	3	4	5	strongly disagree
3	The proceeding in the tutoring session is well-managed. strongly agree	1	2	3	4	5	strongly disagree
4	The content of discussion is systematic, well-organised and substantial. strongly agree	1	2	3	4	5	strongly disagree
5	The group members all strive to search and collect information. strongly agree	1	2	3	4	5	strongly disagree
6	Students are keen on PBL. strongly agree	1	2	3	4	5	strongly disagree
7	Most of the group members acquire knowledge to meet learning objectives. strongly agree	1	2	3	4	5	strongly disagree
8	In the tutoring session, my performance is well in general. strongly agree	1	2	3	4	5	strongly disagree
9	The tutoring session facilitates the interaction among classmates. strongly agree	1	2	3	4	5	strongly disagree
10	The tutoring session greatly increases my own knowledge. strongly agree	1	2	3	4	5	strongly disagree
11	This tutoring session greatly impacts my way of learning. strongly agree	1	2	3	4	5	strongly disagree
Please provide some suggestions or comments for the group members:							
1. What else should be improved?							
2. As compared with the previous facilitated session, what has and has not improved?							