

## Learning Outcomes of Problem-Based Learning between Pre-clinical and Clinical Years of Medical Students

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### Abstract

**Objectives:** To compare learning outcomes of problem-based learning (PBL) between pre-clinical and clinical years of medical students.

**Methods:** The questionnaires were sent to medical students who enrolled during academic year 2012-2015 and they were asked their personal opinion on learning outcomes from PBL by using Likert scale (0-5). The returned questionnaires were divided into pre-clinical (2<sup>nd</sup>-3<sup>rd</sup>) and clinical (4<sup>th</sup>-5<sup>th</sup>) year groups. The difference of opinion rates between both groups were compared by using the independent t Test.

**Results:** The response rate of the questionnaire was 98%. The most of medical students learned by PBL more than 10 times a year. The opinion rates about learning capacity, skills, communications, teamwork and self-assessment were in much agree level (4.34-4.75). The process of applying to reality situation, knowledge management and self-knowledge management were different with statistical significance between both groups ( $p < 0.05$ ). Both groups agree that PBL is a collaborative process ( $p = 0.97$ ). In the pre-clinical students, PBL has made them more applicable to classroom learning. While clinical students found that PBL enabled them to be applied outside the classroom, more specifically, the application of real patient problems improved.

**Conclusion:** Although the skills learned from the PBL were different between pre-clinical and clinical year groups. Group work is still an important factor in successful PBL. When the facilitators understand the specific objectives of mutual learning in PBL, it will encourage medical students to learn effectively.

**Keywords:** Learning outcomes; Problem-based learning; Teamwork; Facilitator

### Introduction

Problem-Based Learning (PBL) is knowledge management which uses problem as the starting point for learning [1-4]. Problem set is a process of research which begins from something that the researchers want to know and set the questions of research [5,6]. Later, they try to find answers in the research. PBL is used to arrange learning in many fields such as medical and sciences fields in order to help students to use logic and know the usefulness of PBL correctly [7,8].

PBL is learning in a small collaborative group setting which focuses on self-directed learning. The objectives are gathering and arranging knowledge to apply in real life, and students are able to develop analytical skills independently [9]. More than that, students are able to develop logic to build efficient self-learning skills, develop skills in teamwork building, and build motivation for learning [10-12]. Many studies have shown that students who succeed in learning with PBL should have the many skills such as lifelong skills in learning, communicating, questioning, constructing hypothesis, and summarizing concepts [13-15]. The strategy of PBL is one of tools which help support students to take action and face problems by themselves. They will practice many kinds of thinking skills such as reviewing, critical thinking, analytical thinking, and creative thinking [16,17]. PBL is a learning experience that is diverse with the nature of the content of the teaching and learning. Therefore, the effectiveness of learning from PBL should begin with the recognition of students as self-learning processes. Students can learn from their past experiences and apply them within the lessons, because PBL is a process of solving problems without seeking answers to the problems [10-12].

Learning by PBL began at the Institute of Medicine, Suranaree University of Technology, in 2007. The learning objectives were to

promote medical students to have self-directed learning and be able to bring PBL techniques to apply to their learning style [18,19] The instructional curriculum managers brought PBL to apply in learning in some subjects or hybrid-PBL, and they have continually improved their evaluation model. The Institute had adapted the curriculum into the 2nd revision in 2012, with the change of teaching method from subject-based to system-based teaching. Therefore, the use of PBL has been integrated into each subject. Teachers or facilitators have the expectation that medical students will apply the skills they have learned from PBL to further their learning in the higher education years. From the expectation of learning result, there is no evaluation of learning outcome of PBL which challenges teachers how they select the right and suitable tools of learning for the medical students.

### Objectives

This study investigated the effect of PBL on medical students learning outcomes in order to know their capacities which were derived from PBL and their suggestions in teaching management to improve efficiency.

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## Methods

### Educational setting

PBL management in the Institute of Medicine, Suranaree University of Technology has been conducted since the 2nd year of medical students. It takes 2 years of study in the pre-clinical (2<sup>nd</sup>-3<sup>rd</sup>) year class. The learning objectives include: understand the knowledge, application of knowledge, communication skill, teamwork skill and life-long learning. However, it does not handle PBL in the clinical (4<sup>th</sup>-5<sup>th</sup>) year of medical students because they were divided into the affiliated hospital and too small number to set PBL group.

### Study design

It was a cross sectional descriptive study in 2017. The data was derived from a questionnaire consisting of closed-end and open-ended questions. The questionnaire was developed by the researcher and was checked for validity from external auditors. The validity of the content was 0.72. It was self-administered by questioning the level of opinion in the medical students about the competencies arising from the learning set in the learning outcomes of PBL. The level of opinion was divided into 5 levels as per Likert scale as following; 5=most agree, 4=much agree, 3=fair agree, 2=less agree, and 1=least agree.

The questionnaires were sent to medical students who studied in academic year 2012-2015 (2<sup>nd</sup> to 5<sup>th</sup> year of medical students) without random sampling. Student names and codes were closed confidentiality in response to the questionnaire.

### Statistical analysis

All data was recorded and analyzed by Excel program 2013. The statistical comparison between the pre-clinical and clinical year groups used independence t Test. Ethical research was approved by the committee from Suranaree University of Technology.

### Results

The questionnaires were derived from medical students who were eligible for participation, 98% (N=294) completed the questionnaires. The return questionnaires were divided into pre-clinic year group (160 students) and clinic year group (134 students). As shown in Table 1, the number of pre-clinical and clinical students accounted for 54.4% and 45.6%, respectively. The majority of students (72.8%) attended PBL class more than 10 times per academic year.

Level of average opinion in capacities of students in each academic year shown in Figures 1-3. From Figure 1, it demonstrated that medical students in the clinical year thought that they could able to get more knowledge, bring PBL process to apply in learning, develop analytical thinking and make decision rationally when they face with unfamiliar circumstances were in much agree level. An overview of the level of knowledge management in all medical students was found to be highest in the 5th year medical students.

From Figure 2, it demonstrated that PBL could be applied in other subjects at a minimum level in the 2<sup>nd</sup> year compared to the 3<sup>rd</sup> year of medical students. Most of the medical students agreed with the applied

Academic year	Status	n	PBL attending/year
2015	2 <sup>nd</sup> year student	80	< 5 times
2014	3 <sup>rd</sup> year student	80	>10 times
2013	4 <sup>th</sup> year student	74	>10 times
2012	5 <sup>th</sup> year student	60	>10 times
Total		294	--

Table 1: Information of medical students in each academic year and PBL attending.

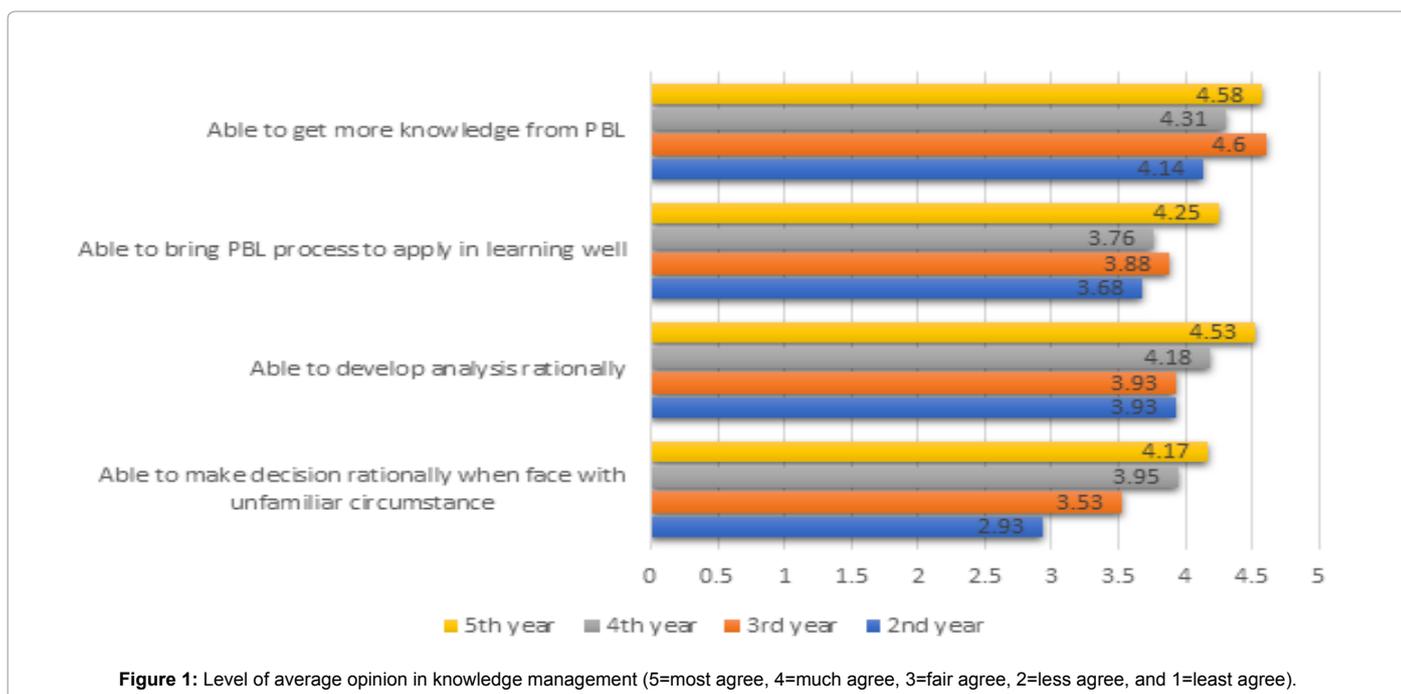


Figure 1: Level of average opinion in knowledge management (5=most agree, 4=much agree, 3=fair agree, 2=less agree, and 1=least agree).

learning process from PBL to appreciate the success of a friend, the self-assessment by finding own strength and weakness and communication skill were developed from PBL in fair to much agree level. However, the lowest level of opinion in the application of knowledge and self-evaluation were found in the 2nd year medical students.

From Figure 3, it demonstrated that most of medical students agree that they could improve their teamwork skills and develop self-directed learning in much to most agree level. Although the medical students in 2nd year did not believe in themselves, they could apply knowledge gained from PBL to their everyday life.

The average score of student opinion compared to the preclinical and clinical year groups shown in Table 2. The result of average opinions in learning outcomes such as understand the knowledge, application of knowledge, analytical thinking, self-assessment, communication skill and life-long learning were different ( $p < 0.05$ ) between both groups. However, it was no statistically significant difference in the skill of team work development ( $t = 0.04, p = 0.97$ ).

The suggestions of other aspects were found that some medical students did not understand the whole step of PBL process clearly, especially when they have just started learning. Despite learning through PBL, they will repeat the content that they have learned from

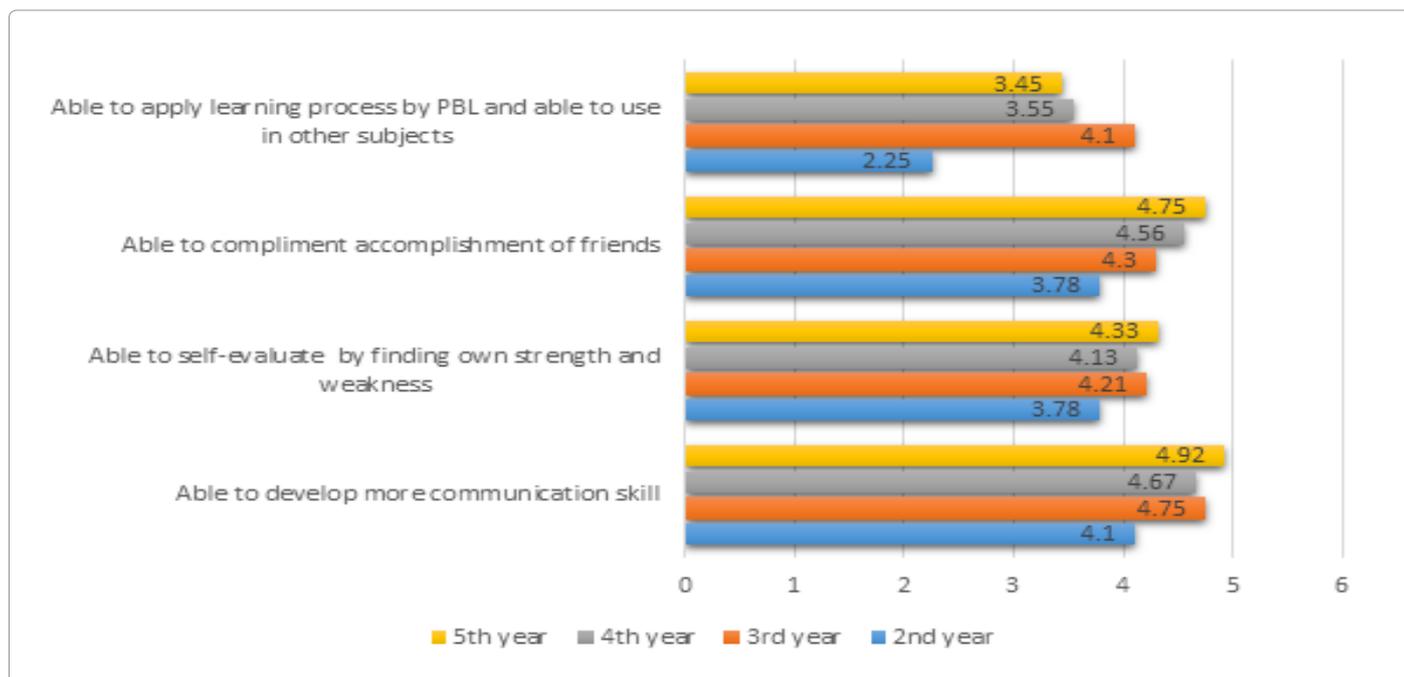


Figure 2: Level of average opinion in the application of knowledge and self-evaluation (5=most agree, 4=much agree, 3=fair agree, 2=less agree, and 1=least agree).

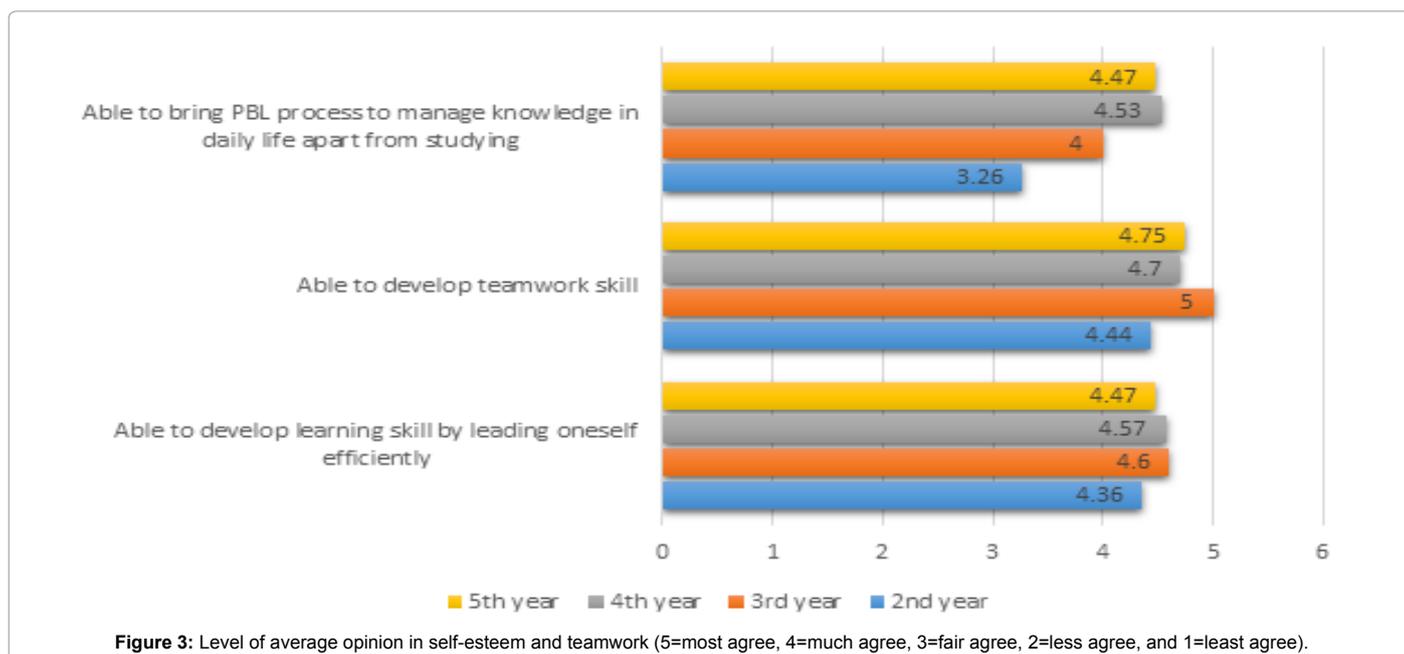


Figure 3: Level of average opinion in self-esteem and teamwork (5=most agree, 4=much agree, 3=fair agree, 2=less agree, and 1=least agree).

Topic/Year class	n	X	S.D.	t	p
<b>Able to get more knowledge from PBL</b>					
Pre-clinic	160	4.14	0.71	3.58*	0.00
Clinic	134	4.43	0.25	--	--
<b>Able to bring PBL process to apply in learning well</b>					
Pre-clinic	160	3.78	0.57	2.12*	0.04
Clinic	134	3.97	0.73	--	--
<b>Able to develop analysis rationally</b>					
Pre-clinic	160	3.93	0.69	4.73*	0.00
Clinic	134	4.33	0.38	--	--
<b>Able to make decision rationally when face with unfamiliar circumstance</b>					
Pre-clinic	160	3.23	0.52	9.60*	0.00
Clinic	134	4.04	0.57	--	--
<b>Able to apply learning process by PBL and able to use in other subjects</b>					
Pre-clinic	160	3.18	1.14	3.13*	0.00
Clinic	134	3.51	0.50	--	--
<b>Able to compliment accomplishment of friends</b>					
Pre-clinic	160	4.04	0.94	6.69*	0.00
Clinic	134	4.64	0.23	--	--
<b>Able to self-evaluate by finding own strength and weakness</b>					
Pre-clinic	160	3.99	0.62	2.57*	0.01
Clinic	134	4.22	0.55	--	--
<b>Able to develop more communication skill</b>					
Pre-clinic	160	4.43	0.40	5.65*	0.00
Clinic	134	4.78	0.17	--	--
<b>Able to bring PBL process to manage knowledge in daily life apart from studying</b>					
Pre-clinic	160	3.63	0.35	12.56*	0.00
Clinic	134	4.51	0.38	--	--
<b>Able to develop teamwork skill</b>					
Pre-clinic	160	4.72	0.35	0.04	0.97
Clinic	134	4.72	0.20	--	--
<b>Able to develop learning skill by leading oneself efficiently</b>					
Pre-clinic	160	4.48	0.40	2.91*	0.00
Clinic	134	4.67	0.22	--	--
<b>Total</b>					
Pre-clinic	160	3.96	0.64	3.61*	0.02
Clinic	134	4.35	0.28	--	--

\*p<0.05

**Table 2:** Comparative average opinions on the ability of medical students between the pre-clinical (2<sup>nd</sup> – 3<sup>rd</sup> year) and clinical (4<sup>th</sup> – 5<sup>th</sup> year) classes.

lecture. Learning with the original group members without the rotation of the members may affect learning in some medical students. So they want to have circulation of members in group for each PBL session. The role of facilitator of each group was different such as controlling time, replying questions for students, planning for teaching and preparing for class, all may have different effects on learning groups. The comments from medical students on other issues, such as preparing in some subjects is less time and summarizing the content at the end of the PBL process from the facilitator. The facilities that affect learning, such as internet signals were not through and written boards were not enough. For the clinical year medical students, they realized that learning in PBL was important for continuous learning from pre-clinical year. Because of in the clinical year class, the application of PBL is applied to the learning process when they face with real patients more than in pre-clinical year class. Therefore, when the clinical year of medical students face with real patient, they were able to create long term knowledge and problem-solving skill well.

## Discussion and Conclusion

In this study, most medical students received the PBL more than 10

times a year, except in the 2<sup>nd</sup> year medical students, which during the data collection phase has just started PBL study in the final semester in 2<sup>nd</sup> year class. There are no PBL classes in the clinical year because the medical students have to separate into different departments and too few students to teach in PBL. It may have an impact on the continuum of learning from the pre-clinical class. Although the level of opinion in all learning outcomes was minimal in the 2<sup>nd</sup> year of medical students because the PBL group study had started teaching. The pre-clinical year students did not learn from real clinical situation like clinical year students so that they were unable to connect characters of scenario from PBL correlate with the symptoms in the real patient. For teamwork, it is found that PBL process was able to develop skill of teamwork and respect other people's opinion. When the teacher opens the opportunity for the student to discuss the content with the group members, it will be part of helping them learn effectively. The more students are communicating or commenting on a group's learning, the more likely they are to improve their teamwork skills. This achievement will improve the social skills of the medical students in the future. The ability to assess strengths and weaknesses in learning process is important if the facilitator encourages students to self-assess

after each lesson of PBL [20]. Because the PBL group study in the pre-clinical class of our educational setting is a learning from the simulated situation, so teachers may still not be able to evaluate now that pre-clinical students can apply their knowledge and learning skills to their daily lives appropriately until they are enrolled in clinical year class. PBL instruction teaches medical students to take self-study in order to give them enough practice to deal with new problems. Therefore, it is imperative to keep track of each student's learning performance until they graduate in the curriculum [21].

PBL does not have only one pattern but it is able to create patterns from model to be any patterns [22-24]. PBL learning does not only help learners to have suitable qualification for career in the future or is not for bringing educational technology to apply in learning but it focuses on process of learn which help learner to be able to live in environment which is complicated suitably [25]. Therefore, the efficiency of PBL should begin from students' perception who accept learning by PBL which is different from passive learning. Then, the students will have responsibility of self-learning because learning by this process focuses on learning process not the result. The students will be able to evaluate result of learning by themselves and they are able to be evaluated by members of group. Also, it helps to practice skill of teamwork to be efficient. The role of facilitator is important for supporting learners to meet objectives. If the teachers understand the purpose of PBL, it will help students achieve their learning objectives. Because the role of teachers in PBL is not to teach content but to teach the process of finding content in learning [26].

The evaluation of the PBL in the capacity of life-long learning is constantly be challenging. If it is possible to assess whether a PBL student can be used to improve lifelong learning, it may be a significant turning point in developing a student-centered curriculum.

## Limitations of the Study

This is a study of the outcome of studying PBL in a single institution. If a comparative study of the learning outcomes of PBL in medical students from many institutions may increase the confidence of the results.

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