



# Comparing the effects of problem-based learning and the traditional lecture method on critical thinking skills and metacognitive awareness in nursing students in a critical care nursing course☆



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## ABSTRACT

**Background:** Problem-based learning (PBL) is a method used to develop cognitive and metacognitive skills in nursing students.

**Objectives:** The present study was conducted to compare the effects of PBL and the traditional lecture method on critical thinking skills and metacognitive awareness in nursing students in a critical care nursing course.

**Design:** The present study was conducted with a quasi-experimental, single group, pretest-posttest design.

**Methods:** A group of third-year nursing students ( $n = 40$ ) were recruited from Khorramabad School of Nursing and Midwifery in the west of Iran. The lecture method was used in one group over the first eight weeks of the first semester and PBL was adopted in the second eight weeks. Standardized self-report questionnaires including The California Critical Thinking Skills Test-B (CCTST-B) and the Metacognitive Awareness Inventory (MAI) were administered before and after the use of each of the instruction methods. Data were analyzed in SPSS using the paired  $t$ -test.

**Findings:** No significant changes were observed in the students' critical thinking skills and metacognitive awareness after performing the lecture method. However, a significant increase was observed in the overall critical thinking score ( $P < 0.01$ ) and its sub-scales of evaluation and deduction ( $P < 0.05$ ) and in the overall metacognitive awareness score ( $P < 0.001$ ) after performing the PBL method.

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## 1. Introduction

In the rapidly advancing healthcare environment of the contemporary society, professional nurses (Kong et al., 2014) and nursing students need to develop their critical thinking skills as a way to prepare for greater expertise in flexible, individualized, situation-specific problem-solving (Klunklin et al., 2011; Kong et al., 2014). Accrediting agencies urge nursing education to present a curriculum that trains

students with high levels of cognitive and metacognitive skills, such as critical and reflective thinking skills (Josephsen, 2014).

## 2. Literature Review

Critical thinking is a purposeful, self-regulatory judgment that results in interpretation, analysis, evaluation and inference (Hajrezayi et al., 2015). Critical thinking is a major component of the discipline of nursing as well as nursing education (Kong et al., 2014). Walsh and Seldomridge have confirmed the positive effects of critical thinking on the quality of care provided to patients (Burrell, 2014). A study conducted by Moghadam identified the relationship between fostering critical thinking skills in nursing students and an evidence-based performance (Poodeh Moghadam et al., 2015).

Critical thinking entails cognitive and metacognitive components (Vaghar Seyyedini et al., 2009) and meaningful learning through

☆ Type of study: a quasi-experimental, single group, pretest-posttest design.

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metacognition is one of the main objectives of nursing education, i.e. the training of autonomous and self-directed learners (Chiejina and Ebenebe, 2013). According to Allen and Armour-Thomas (1991), metacognition contains its own knowledge and control of learning processes (Sart, 2014). Through developing metacognitive skills, including self-awareness, self-evaluative and self-reflective skills, nursing students can learn to view situations from different perspectives and use and interpret their new knowledge (Josephsen, 2014). Some empirical studies have reported nursing students with good metacognition to have a better academic performance compared to those with poor metacognition (Hsu and Hsieh, 2014).

Despite the emphasis in nursing curricula on fostering critical thinking skills and metacognitive awareness in nursing students, the results obtained from previous studies suggest poor and moderate levels of competence in these skills in nursing students, particularly in Iran. Using the Watson-Glaser Critical Thinking Test, Eslami & Moarefi reported poor critical thinking skills for Iranian nursing students (Poodineh Moghadam et al., 2015). A study conducted by Salehi et al. showed that nursing students rarely use the concept mapping strategy for developing their metacognition (Salehi et al., 2013). Some studies have shown the relationship between poor critical thinking skills and metacognitive awareness and nursing students' inability to solve problems, the widened gap between theory and practice, indecisiveness and poor clinical reasoning (Hajrezayi et al., 2015).

Nursing students should utilize cognitive and metacognitive strategies to elucidate multifaceted solutions for complex problems (Doyle, 2013). Problem-based learning (PBL) has been the focus of this shifted attention and it is expected to help develop students' critical thinking skills and metacognitive awareness (Sart, 2014). PBL is a student-centered instruction method in which students take on an active role in their own learning. Previous studies have suggested that students who have received instructions through PBL have better problem-solving abilities compared to those who have received instructions through lectures (Choi et al., 2014; Klunklin et al., 2011). In one qualitative study, Dornan et al. (2005) showed that PBL facilitates self-directed and lifelong learning (Choi et al., 2014). A study conducted by Harris and Hofer (2011) also suggested that PBL increases critical thinking skills, independent study skills, deductive abilities and active participation (EL-Shaer and Gaber, 2014).

Studies conducted in Iran show that PBL increases students' general knowledge on and skillfulness in all the five steps of the nursing process (Khatiban and Sangestani, 2014). Mori et al. also showed that PBL has been beneficial to nursing students in their self-learning, learning integrity and learning communication skills after three years of implementation (Khatiban and Sangestani, 2014; Mori et al., 2006). However, studies on the effects of PBL on critical thinking have shown mixed results; some have noted nursing students' improved problem-solving, communication, critical thinking and autonomous learning as benefits of PBL (Kong et al., 2014), while other studies have claimed that PBL does not improve critical thinking. In one review study, the author concluded that the evidence at hand does not support the development of critical thinking through PBL (Kong et al., 2014; Poodineh Moghadam et al., 2015). Another study found no significant differences between the effects of PBL and lecture on self-directed learning and problem solving skills in first-year nursing students; however, this study has failed to determine whether or not PBL can produce better outcomes compared to the traditional method (Choi et al., 2014). The majority of studies conducted on nursing students' critical thinking have been descriptive in approach and have been concentrated in the US and western or Asian countries such as South Korea (Hunter et al., 2014). Most theoretical models have conceptualized metacognition as a predictor and have less examined the effect of learning strategies such as PBL on the development of metacognitive skills as a learning outcome. Some studies have thus proposed further studies to be conducted on the effect of critical-reflective thinking-based strategies on nursing students' metacognitive skills in other societies such as Iran (Hsu and Hsieh,

2014; Vaghar Seyyedini et al., 2009). In Iran Some studies have shown that most nursing educators rely on content-based teaching methods and prefer a formal learning environment with the lowest amount of student participation (Azizi-Fini et al., 2015). Given the previous findings on Iranian nursing students' poor or moderate critical thinking skills and metacognitive awareness, and since PBL is based on a constructivist theoretical framework that has less been utilized in teaching theoretical courses in nursing, especially critical care nursing courses, the present study aimed to compare the effects of problem-based learning and the lecture method on nursing students' critical thinking skills and metacognitive awareness in critical care nursing courses.

### 3. Methods

#### 3.1. Study Design

The present study is quasi-experimental, single-group and pre-test-post-test in design.

#### 3.2. Study Subjects

All the 40 third-year undergraduate nursing students who had registered for the course of Critical Care Nursing at School of Nursing and Midwifery (in Khorramabad, the administrative town of Lorestan province in the west of Iran) in the second half of the academic year 2012–2013 were invited to take part in the study. These students met the study inclusion criteria, including having registered for the critical care nursing course (three units) and being a third-year undergraduate nursing student. The study exclusion criteria were an unwillingness to take part and participation in other PBL education programs. Considering that only one group of nursing students were accepted during each academic year at the time this study was being conducted, all the 40 third-year students (sixth semester) were chosen for both the intervention and the control groups. The students formed the non-PBL control group ( $n = 40$ ) and were taught by the lecture method first, and then formed the PBL intervention group ( $n = 40$ ) and were taught by PBL and were then compared against themselves.

#### 3.3. Study Tools

The data collection tools used in the present study included a personal information form with eight items (on age, gender, cumulative GPA, etc.) and two questionnaires.

The California Critical Thinking Skills Test form-B (CCTST-B) was the first questionnaire used for measuring the students' critical thinking skills and contained 34 multiple-choice questions with one correct answer. This questionnaire has been specifically designed for measuring critical thinking skills in five domains including analysis, evaluation, inference, deduction and induction. The test takes 40 min to be completed and each correct answer is given a score of 1, making the minimum score obtained zero and the maximum 34. The validity and reliability of this test has previously been determined for use in Iran (Vaghar Seyyedini et al., 2009). In the present study, the test-retest reliability of the test (with a 10-day interval) showed a correlation coefficient of 0.9 and the internal consistency coefficient using Cronbach's alpha was calculated as 0.7 to 0.77 for the sub-scales and as 0.79 for the total scale.

The students' metacognitive awareness was measured using the standard and comprehensive Meta-Cognitive Awareness Inventory (MAI) with 52 items that measure different dimensions of metacognition. Participants respond to each of the items based on a 7-point scale (from totally agree given a score of 1 to totally disagree given a score of 7) and obtain a final score ranging from 52 to 364. This questionnaire has been used in several studies before, and has been reported to have a favorable reliability and validity in Iran. In their study, Vaghar et al. found the reliability coefficient of this scale to be 0.88, (Vaghar

Seyyedini et al., 2009) while in the present study, the Cronbach's alpha value obtained for the overall score was 0.81 for the 20 nursing students who filled out the questionnaire but were not participants of the study.

### 3.4. Data Collection

Data were collected over three stages in one semester using the self-report technique. In the first stage, which began with the academic semester, and before the first session of the Critical Care Nursing course, the CCTST-B and the MAI were distributed among all the 40 nursing students as pretest, and their critical thinking and metacognitive abilities were thus measured in a formal test. In the second stage, the same students completed these questionnaires during their mid-semester as mid-test and again in the third stage at the end of the semester as posttest, and the intended outcomes (improved critical thinking skills and metacognitive awareness) were measured in formal tests. All the stages of assessment were conducted by a trained supervisor who was not a member of the research team.

### 3.5. Intervention

The study began after obtaining permission from the Research Deputy of Lorestan University of Medical Sciences and the authorities at Khorramabad School of Nursing and Midwifery. The critical thinking skills and metacognitive awareness of 40 third-year students were assessed a week before the beginning of the semester. After the pretest was completed, the research team divided the entire content of the Critical Care Nursing course scheduled for 32 two-hour sessions into a lecture part and a PBL part. In this random division of the course content, 16 topics (including emergency or critical care for patients with acute myocardial infarction and acute renal failure, etc.) were allocated for teaching in the lecture part of the course and 16 topics (including emergency or critical care for patients with acute respiratory failure and cerebrovascular accident, etc) for teaching in the PBL part. Following the pretest, the second author held 32 h of lecture including a routine Q&A part for four hours per week and for a total of eight weeks. By the end of the lecture part of the course, which coincided with the students' mid-term, the researchers measured the students' critical thinking skills and metacognitive awareness once again. However, prior to beginning the PBL intervention, the students received a two-hour session of training on teamwork and the principles of PBL. All the 40 students who had formerly made up the lecture group now formed the experimental group to have a PBL educational intervention performed on them and were randomly divided into four groups of ten. Each group was directed by a facilitator that had been trained and practiced over a two-week course to teach the use of PBL. Two facilitators, each with over 4 years of clinical experience, were selected from a pool of clinical instructors from a school of nursing to be responsible for promoting PBL to nursing students. Orientation programs were conducted for facilitators, stressing their roles to help group members understand their objectives and to assist them with searching for solutions and building sustainable agreement.

The PBL intervention began for the intervention group in small groups around the students' mid-term. The educational PBL content and concepts were taught to the students within five learning packages, over 32 h, for four hours per week and for a total of eight weeks. The five learning packages contained a core concept map, learning goals, scenarios and trigger questions. The PBL process was ultimately administered in the following stages:

1- Group clarification: The students clarified the occurrences in the scenario and defined the problem and also noted the unclear concepts. The facilitator encouraged the students to reflect on the subject and debate openly and helped them understand the scenario.

- 2- Brainstorming: The students used their personal ideas and previous knowledge to produce possible explanations for the evaluation of the knowledge and skills required to deal with the situation. The concepts woven into the scenario were clarified and the research subjects were determined.
- 3- Self-directed learning: The students searched for advanced information in textbooks, journal articles and internet sources such as the Medline database. They drafted informative handouts for their peers and prepared critical thinking questions for group discussion. The facilitator encouraged an in-depth understanding and commented on the students' handouts.
- 4- Group discussion: The students shared what they had learnt and debated on the critical thinking questions and provided possible explanations for the situation. The facilitator asked trigger questions.
- 5- Presenting a care plan: Each group prepared a care plan for the problems and shared it in the group. The facilitator helped the students understand why some situations are often more complex than they have initially appeared.
- 6- Evaluation and reflection: The students engaged in self-evaluation, peer evaluation and reflection on what they had learnt and how they had learnt it. The facilitator helped the students in the evaluation of the group's achievements.

Before and after each session, the facilitators discussed the learning objectives and the students' progress in each PBL group and shared their experiences for solving the problems they faced during the implementation of the intervention.

### 3.6. Ethical Considerations

Ethical approval was obtained from the Institutional Review Board of Khorramabad School of Nursing and Midwifery affiliated with Lorestan University of Medical Sciences. The students entered the study on a voluntary basis and submitted their written consent for participation prior to the data collection stage of the study. After signing the consent, a coded demographic questionnaire was administered. Confidentiality of the data were maintained throughout the data collection phase. The students were free to withdraw from the study at any time without any adverse effect on their course grade.

### 3.7. Data Analysis

In addition to using descriptive statistics and after ensuring the normal distribution of the variables (using the Kolmogorov-Smirnov test), the paired *t*-test was used to compare the mean scores and the changes in the scores of critical thinking and metacognitive awareness in both the lecture and PBL groups at a significance level of 0.05. Data were analyzed in SPSS using the paired *t*-test.

## 4. Results

Of the total of 40 students, 62.5% ( $n = 25$ ) were female and 37.5% ( $n = 15$ ) were male, a total of 70.3% of whom were local to Lorestan province and 29.7% were not. The mean age of the study subjects was  $21.89 \pm 1.26$  years. Their high school GPA was  $17.61 \pm 1.52$  and their university GPA  $15.57 \pm 1.1$ . A total of eight students had previously participated in small-group learning settings in their second year at the School of Nursing and Midwifery, but none had recent experience of participation in self-directed learning settings.

The overall mean scores obtained for critical thinking skills and metacognitive awareness were 9.74 ( $SD = 2.13$ ) and 2.5 ( $SD = 54.43$ ) at the beginning of the semester (before the lecture part of their course) and 9.72 ( $SD = 2.44$ ) and 2.47 ( $SD = 50.27$ ) during the mid-term period (after the lecture part of the course and before the PBL part). In other words, there were no significant differences between the mean scores obtained for critical thinking ( $P = 0.833$ ) and

**Table 1**  
Mean scores of critical thinking skills and metacognitive awareness in the lecture group.

Variables (maximum score)	Total (n = 40)		Lecture group (n = 40)	
	Pre-test		Post-test	Paired samples t-test
	Mean (SD)		Mean (SD)	t P-value
Analysis (9)	2.94 (0.88)		2.75 (1.01)	1.022 0.314
Evaluation (14)	3.75 (1.40)		3.67 (1.29)	0.318 0.753
Inference (11)	3.02 (1.51)		3.27 (1.38)	-0.988 0.330
Deduction (16)	4.78 (1.41)		4.67 (1.70)	0.374 0.711
Induction (14)	3.78 (1.63)		3.94 (1.50)	-0.595 0.556
Total critical thinking skill (34)	9.74 (2.13)		9.72 (2.44)	0.213 0.833
Total metacognitive awareness (364)	2.50 (54.43)		2.47 (50.27)	1.439 0.159

metacognitive awareness skills ( $P = 0.159$ ) before and after performing the traditional lecture method (Table 1).

The overall mean scores obtained for critical thinking skills and metacognitive awareness at the end of the semester (after performing the PBL) was 10.75 (SD = 2.41) and 2.76 (SD = 36.91), showing a significant improvement compared to before performing the PBL. After performing the PBL, the students received the highest scores in some of the sub-scales of critical thinking skills, including deduction (5.21 and SD = 1.73) and evaluation (4.32 and SD = 1.52); (Table 2).

The results of the paired *t*-test and the comparison of the mean changes in the pre and post intervention scores obtained in the lecture and PBL groups showed a significant improvement in the students' overall mean scores of critical thinking ( $P = 0.002$ ) and metacognitive awareness ( $P = 0.000$ ) after performing the PBL. The comparison of the mean scores obtained for the different dimensions of critical thinking after the implementation of each of the lecture and PBL methods showed a significant increase in the deduction ( $P = 0.069$ ) and evaluation ( $P = 0.038$ ) sub-scales as a result of performing the PBL (Table 3).

## 5. Discussion

The results of the present study showed the mean critical thinking and metacognitive awareness scores obtained before and after the lecture to be poor and to not have changed significantly. However, after performing the PBL, significant improvements were observed in the overall mean score of critical thinking and its sub-scales of deduction and evaluation and also in the overall mean score of metacognitive awareness in the nursing students surveyed. Previous studies have also shown that using the PBL method increases students' own involvement in learning, thereby leading to improved critical thinking skills, an increased motivation for seeking new information and improved conflict resolution skills (Choi et al., 2014). The results of the present

**Table 2**  
Mean scores of critical thinking skills and metacognitive awareness in the PBL group.

Variables (maximum score)	Total (n = 40)		PBL group (n = 40)	
	Pre-test		Post-test	Paired samples t-test
	Mean (SD)		Mean (SD)	t P-value
Analysis (9)	2.75 (1.01)		3.08 (1.16)	-1.609 0.116
Evaluation (14)	3.67 (1.29)		4.32 (1.52)	-2.213 0.033*
Inference (11)	3.27 (1.38)		3.29 (1.07)	-0.128 0.899
Deduction (16)	4.67 (1.70)		5.21 (1.73)	-2.001 0.053*
Induction (14)	3.94 (1.50)		4.24 (1.89)	-0.843 0.405
Total critical thinking skill (34)	9.72 (2.44)		10.75 (2.41)	-3.360 0.002**
Total metacognitive awareness (364)	2.47 (50.27)		2.76 (36.91)	-5.457 0.000***

PBL, problem-based learning.

\*  $P < 0.05$ .

\*\*  $P < 0.01$ .

\*\*\*  $P < 0.001$ .

**Table 3**  
Comparison of the change scores of critical thinking skills and metacognitive awareness by group.

Variables (maximum score)	Total (n = 40)		PBL group (n = 40)	
	Lecture group (n = 40)		PBL group (n = 40)	Paired Samples t-test
	Mean difference (SE)		Mean difference (SE)	t P-value
Analysis (9)	-0.189 (0.18)		0.324 (0.20)	-1.577 0.141
Evaluation (14)	-0.071 (0.25)		0.648 (0.29)	-1.505 0.038*
Inference (11)	0.243 (0.24)		0.027 (0.21)	0.601 0.551
Deduction (16)	-0.108 (0.28)		0.540 (0.27)	-1.339 0.069*
Induction (14)	0.162 (0.27)		0.297 (0.35)	-0.246 0.807
Total critical thinking skill (34)	-0.054 (0.25)		1 (0.29)	-2.178 0.002**
Total metacognitive awareness (364)	-5.405 (3.75)		25.729 (4.71)	-4.236 0.000***

\*  $P < 0.05$ .

\*\*  $P < 0.01$ .

\*\*\*  $P < 0.001$ .

study demonstrated that PBL increases students' critical thinking skills, as it involves students in learning processes such as problem clarification, assessment of information needs, identification of the relationship between concepts, cooperation between the new forms of knowledge, production of possible hypotheses, debating situation-related issues, considering alternative solutions (Yuan et al., 2008), inquiry, truth seeking, suspending or revising judgment and the acceptance of divergent views (Kong et al., 2014). In contrast, superficial learning methods such as the traditional lecture method focus on extrinsic or external motivations and encourage students to use strategies that require the least expenditure of time and effort for meeting their needs (Hemmati Maslak Pak et al., 2014; Martyn et al., 2014).

However, in the present study, only the overall score of critical thinking and its sub-scales of evaluation and deduction showed a significant improvement in the PBL group for the theoretical course of Critical Care Nursing. These findings imply that the academic level, the content of the theoretical and practical courses and the clinical work experience gained contribute to the development of critical thinking skills. In a study conducted by Choi et al. on first-year nursing students in South Korea, no significant differences were observed in PBL outcomes, including critical thinking, problem-solving and self-directed learning skills, between the PBL and the lecture groups in a theory course and the students' responses were found to vary based on their academic level at the school. First-year and novice students may find it difficult to adapt to PBL because they are used to the lecture method used in high school (Choi et al., 2014). In another study, the bivariate analysis showed a significant relationship between the overall score obtained for critical thinking and its sub-scales, including analysis, deduction, inference, induction and evaluation, and the academic level and nursing associated experience (Hunter et al., 2014).

The present study found a significant difference in the overall scores of critical thinking and some of its sub-scales including deduction and evaluation after performing PBL; however, this difference was not significant in the other sub-scales of critical thinking. Deduction is the process of reasoning from the general to the specific and only the logical form of the argument should be considered in this process. In contrast, induction is a more comprehensive and coherent process compared to deduction and inference; for drawing probable conclusions, people need to have expert knowledge and substantial information (Yuan et al., 2008). The experience of working in clinical settings and facing real patients requires expert knowledge and clinical decision-making skills (Jodat et al., 2014). It therefore appears that using PBL in clinical practice compared to in theoretical practice can result in greater success for nursing students and nurses in the development of the entire dimensions of critical thinking.

An interesting finding of the present study was that, the mean score obtained for sub-scales including analysis, inference and deduction did not change significantly with the use of PBL compared to with the use of the lecture method, perhaps due to the lack of the required standards for the development of all the dimensions of critical thinking, standards such as the learning environment in the classroom. In a study conducted in Australia, the development of critical thinking skills was found to be related to the classroom environment, identified through personal relevance, uncertainty and critical voice; these three factors explained 22% of the variance in the scores obtained for critical thinking skills (Martyn et al., 2014).

In fact, the approach held to PBL is the strongest predictor of the development of critical thinking, characterized by authentic facilitation skills, including guiding the students to explore, evaluate and synthesize ideas freely (Martyn et al., 2014). A valuable approach to PBL that leads to the development of critical thinking is to use concept mapping (CM). Tseng et al. found in their study that a PBL—CM teaching method has both short and long term effects on the competence in critical thinking and self-directed learning and PBL performances such as group interaction, reasoning, leadership and active participation (Tseng et al., 2011).

Not all studies support the results obtained by the present study. For example, in a study conducted by Lyons, critical thinking skills were found to not have developed in a group of students who had received a PBL intervention for one semester (Kong et al., 2014). Another study found teaching through both the traditional lecture method and the PBL method to have improved nursing students' critical thinking skills (Hemmati Maslak Pak et al., 2014). The disparate results obtained for the effectiveness of PBL may be attributed to the complexity of PBL as a form of educational intervention. For instance, different studies use different PBL content and methodologies. Some researchers emphasize the facilitator's role throughout the whole program as a reason for the difference in the success or failure of the PBL method (Kong et al., 2014). A nursing educator should be open-minded, flexible, supportive and approachable (Chan, 2013). In addition to the facilitator's role, the cultural background of nursing students has also been proposed as both an impediment and a facilitator in the adoption of PBL for the development of critical thinking. Nursing educators should therefore use PBL in a culturally congruent manner (Sommers, 2014). In some cultures and countries, students avoid conflicts or do not ask questions from their teachers and are conscious of the tradition seniority systems (Chan, 2013). Such cultures act as an impediment to critical thinking; however, through the reciprocating sharing of nursing information, flexibility and creativity, the development of mutual understanding and the encouraging of growth and reciprocal learning, PBL can become a strong tool for initiating cultural change directed at the development of critical thinking in nursing students (Sommers, 2014).

Another important finding of the present study was the improvements made in metacognitive skills through the adoption of PBL. Studies on metacognition have shown a strong and positive relationship between students' metacognitive skills and their problem-solving, case analysis and learning capacities (Hsu and Hsieh, 2014). In a study conducted by Safari et al., the overall posttest scores of metacognitive awareness and the sub-scales of metacognitive knowledge and regulation improved significantly in the experimental group that had received training on metacognitive strategies compared to in the control group (Safari et al., 2012). In contrast, in a study conducted by Vaghar et al., the guided reciprocal peer questioning teaching approach had led to no significant improvements in the scores obtained for metacognitive awareness in the experimental group compared to in the controls (Vaghar Seyyedini et al., 2009), which shows that certain teaching approaches such as the guided reciprocal peer questioning may be ineffective in the development of metacognitive skills. However, placing reflection and self-directed learning at the center of the PBL approach may lead to more positive results. Education through scenarios, which is what happens over the course of a PBL session, can instigate attempts at reflection during, before and after the occurrence of events.

Reflection, or the monitoring of one's thoughts, is an integral element in the development of metacognitive skills and self-regulated learning (Hsu and Hsieh, 2014). Some researchers have suggested that reflective clinical logs, an interaction style relationship between the teachers and the students and the exchange of experiences with peers and teacher in a non-judgmental milieu can lead to the development of reflective thinking and metacognitive skills (Chiejina and Ebenebe, 2013). A study conducted by Hsu and Hsieh also suggested that the blended learning module can act as a catalyst for the exercising of metacognitive abilities in nursing students (Hsu and Hsieh, 2014). Very few studies have been conducted on the effect of PBL on metacognitive skills; however, a review of literature shows that project-based learning and exposing the students to various social, cultural and economic challenges are vital to the development of their metacognitive skills (Sart, 2014).

### 5.1. Study Limitations

The present study adopted the PBL approach for a limited number of nursing students over a short period of 8 weeks and merely for a course in critical care nursing, which limits the generalizability of the results obtained. Furthermore, given that there were only 40 third-year nursing students available in the study setting, they were not divided into two groups of 20 for fear of a weakened test power; the same group of students who made up the control group were then taken to form the intervention group. Future studies on the subject are recommended to include two separate groups in their study setting so as to prevent the crossover contamination effect. Further studies are also recommended to compare the effects of PBL and other teaching methods such as art-based learning, preceptorship, clinical post conference and case-based learning on critical thinking skills, clinical reasoning, performance skills and metacognitive awareness over longer periods of time and spanning more than one academic semester.

## 6. Conclusion

The present study showed a statistically significant effect for the PBL method on the development of critical thinking skills and metacognitive awareness in nursing students; however, the management of the class and the details of the implementation of PBL are essential for the further development of these skills. Nursing educators can utilize strategies such as concept mapping, questioning, dynamic group sessions, reflective writing, journaling and case-based interventions in their performing of PBL (Sommers, 2014). The results of the present study suggest that the use of PBL can help integrate reflective and critical thinking. Given nursing education's need for critically reflexive curricular in the modern world, adopting a PBL approach can have a central role in the development of clinical judgment, problem-solving, production of knowledge, motivation, self-evaluation and empowerment in nursing students and in guiding them toward lifelong learning.

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### Conflict of Interest

The author reports no financial or other conflict of interest pertaining to the subjects or products discussed in this article.

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