



# The effectiveness of problem-based learning on development of nursing students' critical thinking: A systematic review and meta-analysis



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## ABSTRACT

**Objectives:** The objective of this systematic review and meta-analysis was to estimate the effectiveness of problem-based learning in developing nursing students' critical thinking. **Data sources:** Searches of PubMed, EMBASE, Cumulative Index to Nursing and Allied Health Literature (CINAHL), Proquest, Cochrane Central Register of Controlled Trials (CENTRAL) and China National Knowledge Infrastructure (CNKI) were undertaken to identify randomized controlled trials from 1965 to December 2012, comparing problem-based learning with traditional lectures on the effectiveness of development of nursing students' critical thinking, with no language limitation. The mesh-terms or key words used in the search were problem-based learning, thinking, critical thinking, nursing, nursing education, nurse education, nurse students, nursing students and pupil nurse.

**Review methods:** Two reviewers independently assessed eligibility and extracted data. Quality assessment was conducted independently by two reviewers using the Cochrane Collaboration's Risk of Bias Tool. We analyzed critical thinking scores (continuous outcomes) using a standardized mean difference (SMD) or weighted mean difference (WMD) with a 95% confidence intervals (CIs). Heterogeneity was assessed using the Cochran's Q statistic and  $I^2$  statistic. Publication bias was assessed by means of funnel plot and Egger's test of asymmetry.

**Results:** Nine articles representing eight randomized controlled trials were included in the meta-analysis. Most studies were of low risk of bias. The pooled effect size showed problem-based learning was able to improve nursing students' critical thinking (overall critical thinking scores SMD = 0.33, 95%CI = 0.13–0.52,  $P = 0.0009$ ), compared with traditional lectures. There was low heterogeneity (overall critical thinking scores  $I^2 = 45%$ ,  $P = 0.07$ ) in the meta-analysis. No significant publication bias was observed regarding overall critical thinking scores ( $P = 0.536$ ). Sensitivity analysis showed that the result of our meta-analysis was reliable. Most effect sizes for subscales of the California Critical Thinking Dispositions Inventory (CCTDI) and Bloom's Taxonomy favored problem-based learning, while effect sizes for all subscales of the California Critical Thinking Skills Test (CCTST) and most subscales of the Watson–Glaser Critical Thinking Appraisal (WCGTA) were inconclusive.

**Conclusions:** The results of the current meta-analysis indicate that problem-based learning might help nursing students to improve their critical thinking. More research with larger sample size and high quality in different nursing educational contexts are required.

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### What is already known about the topic?

- Problem-based learning has been widely used to enhance nursing students' critical thinking in nursing education.
- Many studies have examined the effects of problem-based learning on critical thinking in nursing students, but findings have been mixed.
- Previous literature review indicated a positive relationship between problem-based learning and improved critical thinking in nursing students.

### What this paper adds

- This review indicated that nursing students' critical thinking was improved with the use of problem-based learning, compared with traditional lectures.
- There is a need for more research with larger sample size and high quality to further support the effects of problem-based learning on critical thinking development within different nursing educational contexts.

## 1. Introduction

In a contemporary health-care environment characterized by rapidly changing developments and relentlessly increasing knowledge, professional nurses need to develop critical thinking skills that will provide them with expertise in flexible, individualized, situation-specific problem-solving (Higgs and Jones, 2000). Critical thinking is conceptualized to include both cognitive skills and affective dispositions by the American Philosophical Association (APA) (Facione, 1990), and is considered to be a professional attribute for nurses in the new millennium to make efficient judgments in fast-changing clinical situations (Chen and Lin, 2003). Critical thinking is a significant component of nursing education and integral to the discipline of nursing (Bowles, 2000; Boychuk Duchscher, 1999). It is important to nursing practice where wise decision-making, correct judgment and effective communication are integral to safe and effective patient care outcomes (Jones, 2008). Fostering critical thinking ability in nursing students has become one of the most imperative tasks for nursing education (Lyons, 2008).

Determining instructional strategies which enhance critical thinking abilities of nursing students has been of interest to nurse educators and a focus of nursing research for two decades (Riddell, 2007; Scheffer and Rubenfield, 2000). There are several teaching methods in the nursing literature to enhance critical thinking in nursing students, such as group discussion (Platzer et al., 2000), case studies (Tomey, 2003), concept mapping (Abel and Freeze, 2006) and problem-based learning (PBL) (Jones, 2008). Among these, PBL has become more prominent in nursing education as a strategy for promoting critical thinking (Worrell and Profetto-McGrath, 2007).

PBL originated at the McMaster School of Medicine in Canada in 1965 (Berkson, 1993), and was further refined by Dr. Howard Barrows as both a curriculum strategy and a process approach in 1988. PBL is a student-centered approach to learning which enables the students to work

cooperatively in small groups for seeking solutions to situations/problems (Rideout and Carpio, 2001). PBL presents students with a problem or situation to apply previous knowledge and acquire new knowledge. There are five steps in the PBL process: analysis of problems, establishment of learning objectives, collection of information, summarizing and reflection (Lin et al., 2010). In the PBL model students encounter the problem-solving situations in small groups. The groups have to decide what information they need to identify the situation/problem at issue, try to understand it, communicate it to the others in the group, and then re-formulate it in such a way that they can deal with the problem (Yuan et al., 2008b). PBL makes the meaningful of learning and makes the learner to develop skills to thinking critically (Kammanee, 2008).

Some studies have examined the use of PBL as a teaching method to enhance critical thinking, but findings have been mixed. Some studies have showed PBL produced clear benefits for students, such as increased autonomous learning, critical thinking, problem-solving and communication (Cook and Moyle, 2002; Morales-Mann and Kaitell, 2001). Joe and Elizabeth (1999) found that nursing students who participated in a one-year PBL course showed improved critical thinking. When compared with traditional lectures, some researchers have found PBL does not improve critical thinking (Choi, 2004; Lyons, 2006), however many researchers have found PBL is more effective in fostering critical thinking skills of nursing students (Dehkordi and Heydarbejad, 2008; Jones, 2008; Ozturk et al., 2008; Tiwari et al., 2006; Wang, 2009).

A systematic review in 2008 (Yuan et al., 2008b) including studies between 1999 and 2006 was conducted to demonstrate whether PBL actually had more effect on developing nursing students' critical thinking compared with other instructional methods. Keywords that guided the search were problem-based learning, critical thinking, nursing and effect. Ten articles were selected, among which, six were descriptive. The ten studies were described from the six following aspects: study level of evidence, design, sample, instruments, intervention and findings. The authors concluded that in theory, the use of PBL may promote critical thinking in nursing students, but the available evidence in this review did not provide supportive evidence on developing nursing students' critical thinking through PBL. In another review (Oja, 2011) the literature search were identified through the formulation of a PICO (Population, Intervention, Comparison and Outcome) question to examine the evidence regarding the use of PBL to improve critical thinking. The literature search included the keywords nursing, problem-based learning and critical thinking. The systematic review in 2008 (Yuan et al., 2008b) and an additional four studies were included. In addition to the key information of the included studies, the author added the strengths and weaknesses. The evidence indicated a positive relationship between PBL and improved critical thinking in nursing students. The two previous reviews gave the detailed description of the studies that compared PBL with traditional lectures on the effectiveness of development of nursing students' critical thinking, however, a quantitative evaluation is still lacking.

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