

The Effectiveness of Problem-Based Learning in Undergraduate Nursing Programs: A Scoping Review of the Literature

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Abstract

Introduction: Problem-based learning (PBL) working as an innovative student-centered teaching method has been tested for its effectiveness among considerable primary studies. While there is still lacking firm evidence in the nursing educational field about its efficacy. The different paper reports different research result about an application of PBL methodology.

Objectives: The purpose of this scoping review was to appraise and examine the range of recent available evidence on the effectiveness of problem-based learning in undergraduate nursing programs.

Research Strategy: Used Medline, The Cochrane Databases of Systematic Review, and The Database of Abstract of Reviews of Effect (DARE), Cumulative Index to Nursing and Allied Health Literature (CINAHL (via Ebsco)) to search English language literature. Adopted P (population) C (concept) C (context) framework to identify keywords and index terms, and the reference list of some high level of evidence was lastly searched for additional studies.

Methodological quality: Each paper was assessed for its eligibility and methodological quality with JBI Critical Appraisal tools (Appendix 1) before inclusion in this review. The level of evidence of each retrieved study was assessed according to New JBI Levels of Evidence (Appendix2) developed by the Joanna Briggs Institute Levels of Evidence and Grades of Recommendation Working Party October 2013. High level of evidence such as systematic reviews, randomised control trials, quasi-experimental studies were given priority.

Discussion: Considerable primary studies have reported PBL produced a positive outcome for nursing students, while none of them gave firm evidence about the effect of PBL on nursing students' critical thinking development, knowledge competence, learning motivation, attitude, and performance. Critical thinking, as the vital evaluation element of each study, whether relates positively to the other skills was uncertain. The validity and reliability of evaluation instruments in each study in nursing discipline were still controversial.

Conclusion: No strong conclusion had been made from this review, and more research with large sample size is needed to examine the effectiveness of PBL among nursing programs. Long-term effects of outcomes and cost effectiveness were suggested to be measured in future studies. The effectiveness' appraisal instruments in nursing discipline were called for adjustment and development.

Keywords: Literature review, problem-based learning, undergraduate nursing programs, nursing curricula, Baccalaureate nursing course, critical thinking

Introduction

During the last decade, with rapid advances in technology, rapid changing developments, and increasing patient acuity, it has

been recognised that nursing education and healthcare are facing numerous challenges [1, 2]. To cultivate professional nurses who can function competently in the workplace, nursing education has been trying to transform traditional lecture-centred method to a new model or teaching methodology [3]. Problem-based learning (PBL) working as a student-centred method has been international examined and tested by many studies all over the world [3-5].

PBL originated from McMaster University Medical School in Hamilton, Ontario, Canada in the 1960s and was later adapted by nursing professionals to teach the nursing student in theoretical and clinical context [6]. PBL requires students to identify and resolve the problems from a “real-case” scenario through the effort of “a small group” with “self-directed learning”. Faculty and “tutors” serve as a facilitator rather than a traditional lecturer to assist the small group to finish the task [7]. Compared to traditional curriculum separating theory and application, emphasizing on memorizing by rote, PBL encourages the student to develop critical and active learning skills and capability [2]. It provides the basis for life-long learning and is becoming increasingly dominant in nursing education field [8]. People hypothesized that PBL would work more effectively and successfully as an innovative teaching method competing to traditional lecture tutorials [9-13]. Indeed, some evidence has reported PBL produced clear benefits for nursing students, such as increased autonomous learning, critical thinking, problem-solving skills and communication [4].

A latest systematic review and meta-analysis conducted by Zhou et al. [13] in pharmacy education elaborated that problem-based learning methodology is superior to conventional education methods in developing students’ learning interest, independent analysis skills, the scope of knowledge, self-study, team spirit, and oral expression [13]. While some other studies failed to find statistical significance with the application of PBL methodology [14]. Also, owing to the differences towards the physical researching environment, the length of PBL implementation, and preference of the researchers, each study designed different evaluation variables, and measurement instruments. Although considerable primary research has been conducted to test the effectiveness of PBL methodology in nursing education discipline, [4, 11, 14] rather less literature review has been devoted to appraising and synthesizing the efficacy of PBL among undergraduate nursing students. The aim of this study was thus to integrate available evidence on the effects of PBL about nursing education and add some recent evidence regarding on the evaluation variables and measurement instruments in each study. The specific review questions considered are as follows:

1. Is there any review have evaluated the effectiveness of PBL among undergraduate nursing curricula?
2. What are the new evidence of the effectiveness of PBL among undergraduate nursing students?
3. What kind of evaluation variables were appraised in selected new studies?
4. What kind of measurement instruments were used in included new studies?

Review Method

Inclusion criteria

Compare to a typical systematic review aims to answer a specific question (or series of questions) based on very precise inclusion criteria, for example, a systematic review may pose a precise question based upon the PICO (Population, Intervention, Comparator, and Outcome) elements of its inclusion criteria. A scoping review will have a broader “scope” with correspondingly less restrictive inclusion criteria based upon the PCC (Population, Concept, and Context) elements. The following inclusion criteria were used to determine which papers were to be included in this review, and articles that met all of the inclusion criteria were retrieved assessed for quality.

Types of participants

This review considered studies that involved undergraduate nursing students (college and university), nursing staffs and nurses in all the possible domains of interest who have participated in nursing educational programs.

Types of study

The review considered all types of research papers investigating the effectiveness of problem-based learning in undergraduate nursing programs or nursing curricula, while a high level of evidence such as systematic review, randomise control trial (RTC), quasi-experimental studies, cohort studies were given priority.

Concept

Literature or reviews that pertain to the implementation of PBL were addressed in this article, accepting that the particular interventional process details might differ slightly from each one of the studies.

Context

As different kinds of measurement tool of results were used in various studies, papers described the effectiveness of PBL in self-directed learning, Problem-Solving, critical thinking were considered. Studies have quantitative outcomes on participants’ learning performance, knowledge competence, satisfaction, or patients’ health outcomes were all selected for analysis.

Search Strategy

The aim of the search strategy was to find both published and unpublished (grey literature) primary studies as well as reviews with time limitation from 2006-2016. To gain a comprehensive insight into the effectiveness of PBL within the domain of nursing education, papers from different countries written in English were all considered. However, high level of evidence such as systematic review, randomize control trial (RTC), and quasi-experimental study etc. were given priority to be included in this scoping review. An initial limited search of MEDLINE, Scopus and CINAHL (via Ebsco) were undertaken followed by an analysis of the text words contained in the title and abstract of retrieved papers, and of the index terms used to describe the articles. A second search using all identified keywords and index terms were then undertaken across Cochrane Databases of Systematic Review, The Database of Abstract of Reviews of Effect (DARE), EMBASE Joanna Briggs Institute, and OVID Nursing database. Thirdly, the reference list of some identified reviews and theoretical overviews will be searched for additional studies. The search terms were used in MEDLINE database as below.

1. Problem-based learning
2. PBL
3. 1 OR 2
4. nurs* program
5. nurs* curricula
6. education
7. undergraduate
8. pre-registration
9. 4 OR 5 OR 6 OR 7 OR 8
10. effectiveness
11. effective
12. 10 OR 11
13. 3 AND 9 AND 12
14. Limit 13 to yr =“2006-2016”

All papers identified during the database search were assessed for relevance to the review based on the information provided in the title and abstract. The full report of the paper was retrieved if the paper appeared to meet the inclusion criteria and it was again assessed for applicability to the inclusion criteria to determine the relevance to the review objective.

Results

Description of studies

A total of 236 papers were identified as potentially relevant to the review question in the first step of searching, out of which 175 duplicates were removed. A further 50 articles were excluded based on an examination of the title and abstract. Papers excluded from this review either because they are qualitative studies, or there was no result presented in them. 11 papers were retrieved for evaluation with respect to the inclusion criteria and methodological quality. 4 out of 11 papers did not focus on nursing students, and 2 cases were excluded from this literature review since it focuses on Doctor of nursing practice (DNP) graduates [11] rather than undergraduate nursing students. Thus, five articles were included in this scoping review, comprising two systematic review, two quasi-experimental studies, one observational analytic study (Table 1).

| source/country | study/design | population | target measurement | key findings | measurement tool |
|--|--|--|---|---|--|
| Kong et al. 2014; (China) | systematic review and meta-analysis (9 studies) | PBL group = 399 NPBL group = 511 nursing student | critical thinking | problem-based learning might help nursing students to improve their critical thinking | (CCTDI) (CCTST) (WGCTA) |
| Yuan, Williams & Fan 2008 (China) | systematic review (10 studies) | 734 nursing student | critical thinking | no strong conclusion made | (CCTST) (CCTDI)(WGCTA) |
| Khatibian & Sangestani 2014 (Iran) | quasi-experimental | 70 third-year undergraduate nursing (n1=34, n2=36) | 1. students' general and special knowledge and skills; 2. Students' attitudes 3. problem-solving ability | 1. significant improvement (P < .001) 2. significantly better (P < .001) 3. enhancement (P < .001) | 1. questionnaire with A) 15 items B) 19 items 2. five-Likert scale (21 items) 3. checklist (14 items) |
| Hwang & Kim 2006 (USA) | quasi-experimental | 71 second-year nursing (n1=35, n2=36) | 1. students' level of knowledge 2. students' attitude 3. students' learning motivation | 1. increase (t = 2.007, p = .045) 2. increase (t = 2.608, p = .012) 3. No statistically significant difference (t = 1.669, p = .100) | 1. A multiple-choice examination 2. A 16-item questionnaire 3. A 27-item questionnaire |
| Ozturk, Muslu & Dicle 2008 (Turkey) | observational analytic | 147 participants (n1=52, n2=95) | 1. critical thinking | 1. significant differences were found (P < .005) | (CCTDI) |

Review

Two systematic reviews [9, 12] evaluating the effectiveness of problem-based learning in the development of nursing students' critical thinking were identified. One systematic review and meta-analysis [9] adopted keywords that guided the search were 'problem-based learning (PBL)', 'critical thinking', 'nursing education', 'meta-analysis', 'systematic review'. The characteristics of the selected night studies were described from the eight following aspects: study ID (country), sample size, participant characteristic, interventions, comparator, timing, measurement tools, and duration of the intervention. The critical thinking skills outcome were appraised with the Assessment Technologies Institute Critical Thinking Test (ATI, 2002), [15] Bloom's taxonomy of the cognitive learning domain, [16] the California Critical Thinking Dispositions Inventory (CCTDI), [7, 17] the California Critical Thinking Skills Test (CCTST) [12] and the Watson–Glaser Critical Thinking Appraisal (WGCTA) in this systematic review. Nine articles representing eight randomized

controlled trials were included in the meta-analysis, out of which seven studies involving 910 participants (PBL group = 399, control group = 511) reported overall critical thinking scores, while two studies showed no statistically significant differences in nursing students' overall critical thinking scores between the PBL and the control group. This systematic review concluded that problem-based learning might help nursing students to improve their critical thinking. However, since critical thinking had been defined in a variety of ways, and there were several standardized tests used to measure critical thinking, so the different validity and reliability of instruments might influence the meta-analysis outcome measure.

Another systematic review [12] addressed research questions 'what is the effect of PBL on nursing students' critical thinking?' and 'does the available evidence provide information for developing nursing students' critical thinking through PBL?' with rigorous evidence criteria. A total of ten papers were retrieved in this review to measure differences in critical thinking among nursing students in PBL. A table described the reviewed studies' level of evidence, design, sample, instruments, intervention, and findings combine with a rigorous outcome measurement. Data extracted from each study related to student's perceptions of the change in critical thinking was measured with California Critical Thinking Dispositions Inventory (CCTDI), The California Critical Thinking Skills Test (CCTST) and The Watson–Glaser Critical Thinking Appraisal (WGCTA) [18]. However, the review reported that due to possible modification of some traditional learning method and mixed delivery of PBL and Non-PBL to courses, it is hard to detect the critical thinking skills' improvement among students. Further, as the definition of critical thinking, the validity, and reliability of instruments differ in a variety of ways, the review failed to provide robust evidence about the effectiveness of PBL on nursing students' critical thinking development. The authors recommended additional research with large sample size, and high quality should be conducted to clarify the effects of PBL on critical thinking development within nursing educational context.

A quasi-experimental design [4] was conducted to compare the effects of PBL with traditional clinical education among 70 third-year undergraduate nursing students. It was performed with a non-equivalent control group (PBL=34 students and NPBL=36 students) pre-test and post-test design; and a non-equivalent control group only post-test design for the students' attitudes and performance. In this trial, the research instruments were three questionnaires and a checklist designed by the researchers:

- Comparison of the students' general and special knowledge and skills self-evaluation via paired t-test before and after the clinical course was conducted with a questionnaire with two parts. Part A contains 15 items named "General expected knowledge and skills in applying Nursing Process"; part B covers 19 items titled "Special expected knowledge and skills in applying Nursing Process".
- Students' attitudes toward their learning experiences after the clinical course was analysed based on the Pearson correlation test with a self-rating scale. The 5-Likert scale contains 21 items with an open-ended question named "Students' attitudes toward their learning experiences", which ranges from strongly disagree = 0 to strongly agree = 4.
- Students' ability to solve the patients' problems after the clinical course was evaluated. Adopting a checklist with 14 items to

assess their performances in five steps of NP (assessment, diagnosis, planning, implementation, and evaluation).

This trial indicated a significant improvement in PBL students' general and special competencies ($P < .001$). The PBL students' attitude was significantly better than the control group ($P < .001$) as well. There was also an incredible enhancement only in the PBL students' performance ($P < .001$). This study concluded that Problem-based learning fostered nursing students' competency, attitude, and performance.

A quasi-experimental study [14] with a control group, pre-test and post-test design reported a significant increase in terms of the level of knowledge ($t = 2.007$, $p = .045$) and learning motivation ($t = 2.608$, $p = .012$) in the PBL group in an Adult Health Nursing course. In this trial, the Instruments adopted to evaluate the research results are as follow:

- A multiple-choice examination developed by the investigator was used to assess the level of knowledge;
- A16-item questionnaire from a Learning Attitude Measuring Scale (LAMS) by the Korean Educational Development Institute was modified to measure students' learning attitudes;
- A 27-item questionnaire from an Instructional Materials Motivation Survey (IMMS) of Keller was modified to evaluate the level of learning motivation.

However, no statistically significant difference was discovered between the PBL group and lecture groups in the level of attitude towards learning ($t = 1.669$, $p = .100$).

An observational analytic study [7] involving 147 participants ($n_1=52$, $n_2=95$) compared the levels of critical thinking among senior nursing students between two educational programs (PBL and Non-PBL). After one semester different educational intervention, a post-test data was collected with California critical thinking disposition inventory (CCTDI), which was followed by a t-test analysis. Besides a significant difference ($p < 0.05$) was reported of the critical thinking disposition scores in this trial, analysis of sub-scale scores also showed a substantial improvement in 'truth-seeking' and 'open-mindedness'. While this differs from the outcome of Tiwari et al. [17] according to the authors. No significant differences were found in sub-scales of the critical thinking disposition scale regarding on the "analyticity", "systematicity", "inquisitiveness" and "self-confidence" ($p > 0.05$). This study advocated continuing calls for different approaches to measuring critical thinking since tools like CCTDI only provide limited guidance and encouragement of PBL.

Discussion

There has been growing interest in the effectiveness of problem-based learning teaching method in undergraduate nursing education. Available original evidence has reported PBL produced a positive outcome for nursing students, such as increased autonomous learning, critical thinking, problem-solving skills, and communication. Due to the time limitation, only paper generated after 2006 were selected in this review. No randomised control trials were found partly owing to the particularity of the research topic's nature. Two systematic reviews were level I, [9, 12] two quasi-experimental studies were Level II [4, 14] and one observational analytic study was level III [7] according to New JBI Levels of Evidence (appendix 2). Among them, three studies hypothesized that PBL is more effective in fostering critical thinking skills of nursing student, [7, 9, 12]

while none of them gave firm evidence about the effect of PBL on nursing students' critical thinking development. The other two quasi-experimental studies were trying to evaluate multiple outcomes such as students' knowledge competence, learning motivation, attitude, and performance. However, their conclusions were different and controversial. More studies with large sample size and high quality are needed to provide robust evidence of the effectiveness of PBL in baccalaureate nursing curricula.

So far, among studies and reviews testing student's critical thinking after application of PBL, [7, 17-19] tools such as CCTDI, CCTST, and WGCTA were given the utmost preference to measure critical thinking. So did the three papers selected in this review [7, 9, 12] Gloudenmans, Schalk and Reynaert summarised six standardized instruments for evaluating critical thinking: The California Critical Thinking Disposition Inventory (CCTDI), the California Critical Thinking Skills Test (CCTST), the Health Science Reasoning Test (HSRT), the Watson–Glaser Critical Thinking Appraisal (WGCTA), the Performance-Based Development System (PBDS) and the Critical Thinking Diagnostic (CTD). The most popular instrument CCTDI contains seven scales are Truth-seeking, Open-mindedness, Analyticity, Systematicity, Confidence in Reasoning, Inquisitiveness and Maturity of Judgment (Kong et al. 2014). Participants' judgments about each of seven aspects might be positive, ambivalently, or negatively depending on what they believe and what they want to do. It is widely accepted that cultivating critically thinking skills is the 'most imperative task for nursing education', and it is the key element to accelerate safe and effective nursing care delivery [15]. Nevertheless, according to Searing and Kookan, [10] their study failed to identify meaningful relationships between the CCTDI and student learning outcomes in baccalaureate nursing students. That is, perhaps difficult to say CCTDI or WGCTA is adequately or validly to demonstrate people's critical thinking capability [20]. Further, provided critical thinking can be represented from CCTDI score, it is still uncertain it positively relates to students' knowledge competence, learning motivation, attitude, and performance [10]. Two quasi-experimental studies included in this review used a well-designed questionnaire or checklist assessing more of the education's mode of delivery than the evaluation of PBL methodology itself. Hence, it is calling for different approaches to measuring critical thinking, [7] and more studies to investigate the validity and reliability of appraisal instruments being used in each paper. Perfectly, a specific evaluation instrument can be formulated for nursing discipline [20].

Although only five papers were included in this review, a total of 22 studies were covered and analysed. No study mentioned the long-term effects of PBL after their intermediate post-test. Few study measured health outcomes or cost effectiveness in clinical context post implementation of PBL. It is also suggested that future studies might consider, and more research is needed, to examine the long-term effects of PBL regarding on their health outcomes or cost effectiveness.

Conclusion

This review selected three studies (one systematic review with meta-analysis, one systematic review without meta-analysis and one observational study) appraising critical thinking among undergraduate nursing students with PBL teaching method. While no robust positive evidence was found from them. The other two quasi-experimental studies reported slightly different results based on their designed appraisal instruments. No firm conclusion can be

made from this review, and more research with large sample size and high quality is needed to examine the effectiveness of PBL among nursing programs. Long-term effects of health care outcomes and cost effectiveness were suggested to be measured in future studies. The effectiveness' appraisal instruments in nursing discipline were called for adjustment and development.

Limitations

This review only included a few papers with time limitation compared to a rigorous systematic review. The methodological quality of 19 studies included in selected two systematic reviews was low. No randomised control trials were found due to the impossibility for researchers to conceal and blind allocation. Two quasi-experimental studies and one observational study only adopted small sample size. Data was collected by self-reporting from the participants. Hence, it is unavoidable to produce selection bias, performance bias and measurement bias. However, this review does provide some information about implementing PBL pedagogy and suggests the utilization of a more standardized method to assess PBL.

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