

**PROBLEM BASED LEARNING MODEL IN VIRTUAL ENVIRONMENT CLASS  
IN HEALTH : A SISTEMATIC REVIEW**

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*Review article*

*DOI: [10.32549/OPI-NSC-61](https://doi.org/10.32549/OPI-NSC-61)*

*Submitted: 18 November 2021*

*Revised: 12 January 2022*

*Accepted: 16 January 2022*

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**Abstract**

**Background.** PBL is a student-centred learning method where students determine their own learning goals from clinical-based problems. Many studies have been conducted regarding the effectiveness of PBL based on virtual classes or online classes in various fields of science. This systematic study aims to evaluate the implementation of PBL in various online learning contexts.

**Methods.** This systematic review was conducted using the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) statement. We include intervention studies, training, or educational strategies using PBL method focusing on any health student class, and published between 2010 to 2021. Three authors (RA, MH, HR) performed data extraction. Differences that arise are resolved by consensus, in consultation with other investigators (RS).

**Results.** The search returned 1,678 articles; after removing the duplicated articles, 731 articles remained, of which 721 articles were removed after screening titles and abstracts. The remaining ten articles were reviewed and checked for eligibility, so three articles were excluded. The final results were collected as many as seven articles that met the inclusion criteria.

**Conclusion.** Online PBL is perceived to be an effective educational strategy by lecturer. Overall, the results for PBL in online/virtual class include Positively impact the learning experience, Increase knowledge and skills, improve the learning process, Increased self-learning capacity, motivation, self-monitoring, and interpersonal communication, Improve student understanding and application of theoretical knowledge in a large classroom setting, Increased availability and acceptance, reduced interactivity.

**Keywords:** Problem-Based learning, Virtual, Online Class, Students

## INTRODUCTION

As a modern pedagogical philosophy, Problem-Based Learning (PBL) is increasingly recognized as a critical research area in student learning and pedagogical innovation in health science education [1,2]. In contrast to teaching and learning approaches dominated by conventional lectures, inquiry-based approaches such as PBL encourage students to be actively involved in knowledge construction and develop competencies in various contexts [3]. This review focuses on PBL rather than other inquiry-based pedagogical approaches, such as discovery learning, experiential learning, and project-based learning. Given the high level of technological involvement of 21st-century learners, a new area of research is examining the emerging role of educational technology in PBL [4–6]. Therefore, this study aims to review the application of PBL in the concept of problem-based online classes. What is interesting from this review are studies investigating the effectiveness of online classes in achieving PBL-related student learning outcomes of flexible knowledge, practical problem-solving skills, independent study skills, collaborative teamwork skills, and intrinsic motivation [7,8].

The studies included in this review are studies where educational technology has been adopted to support PBL for undergraduate and postgraduate program learning. Traditional pedagogy, which is teacher-centred, class-oriented, and pressure on exams, places students passively “acceptance” state [9]. PBL is a student-centred learning method where students determine their own learning goals from clinical-based problems [10,11]. As an established approach, PBL has been reported to be suitable for use in graduate medical schools [12]. Recently, PBL has become a subject of considerable interest in postgraduate education. PBL can cultivate postgraduate leadership, teamwork, communication, and problem-solving skills, which are helpful for lifelong learning and facilitate postgraduates to take responsibility for their learning.

The online PBL format has been piloted with varying degrees of success, and although the PBL approach is beneficial for students in various disciplines, the results associated with this strategy are inconclusive in nursing education [13]. One such study compared conventional classroom-based

strategies with problem-based asynchronous learning for part-time public health students. The development of web-based technology has resulted in new ways to implement PBL in large classrooms [14]. New teaching methods facilitated by web-based technologies have been applied in nursing education using web-based PBL methods with promising effects. Web-based PBL also enables better communication between teachers and students. When used with conventional PBL teaching methods, web-based PBL facilitates the development and promotion of more significant self-directed learning and innovation in nursing and other professional education systems.

Many studies have been conducted regarding the effectiveness of PBL based on virtual classes or online classes in various fields of science. It has prompted the author's interest to conduct a systematic study of this review on PBL implementation based on online classes or virtual classes. For this reason, the current study aims to evaluate the implementation of PBL in various online learning contexts.

## **METHODS**

### *Review Protocol*

This systematic review was conducted using the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) statement [15]. The current study tries to evaluate the application of the problem-based learning method in virtual or online learning situations from articles that have been published in the period 2010 to 2021.

### *Searching strategy*

Relevant articles were searched and collected using Scencedirect, Google Scholar, Proquest, Pubmed, and the Wiley Online Library, with a publication time between 2010 and 2021. The search keywords were adjusted according to the Mesh terms for health research. The keywords used vary, depending on the search engine used. In general, the keywords focus on 'Effectiveness' OR 'Effect' OR 'Evaluation' AND 'Problem-Based Learning' OR 'PBL' AND 'Online class' OR 'Virtual class' OR

'virtual meeting' AND 'web-based' OR 'social-media OR 'Online group discussion'.

### *Eligibility*

Inclusion criteria consist of intervention studies, training, or educational strategies using PBL method focusing on any health student class in certain subjects for example Physiology, anatomy, nursing care, community health, etc. Study outcomes such as increased knowledge, attitude, skills, and/or student satisfaction. We choose only articles published in English, and in the time range 2010 to 2021. We excluded or not reviewed books, dissertation, letter to editor, and systematic review study.

### *Study Quality*

Overall articles were assessed using the NIH (National Institutes of Health) quality assessment of controlled intervention studies, for Observational Cohort and Cross-Sectional Studies, and Quality Assessment of Case-Control Studies [16].

A scoring sheet was developed to assess the research methodology and adherence to the scoring criteria for each article that met the inclusion criteria of this study. Articles with scores <30% of the criteria were classified as "poor", scores between 30 and 70% were classified as "moderate", and scores >70% were classified as "good" study quality. The articles taken are classified as moderate and "good".

### *Extraction and Analysis*

Three authors (RA, MH, HR) performed data extraction. Differences that arise are resolved by consensus, in consultation with other investigators (RS) if an agreement is not reached. Main items extracted included: lead author/year, country, purpose of the study, method (Quasi-experimental, Randomized Controlled Trial), evaluation strategies, and results.

Titles and abstracts are screened on each database. Screening for duplicate articles is carried out

using the Mendeley application. Substantive information is extracted from each article into a Microsoft Word table.

The author determined the selection of articles after being reviewed from 7 full-text articles adjusted to the inclusion and exclusion criteria. Data extraction was carried out with care. The interpretations are presented in the table by taking the critical parts of the article.

## **RESULTS**

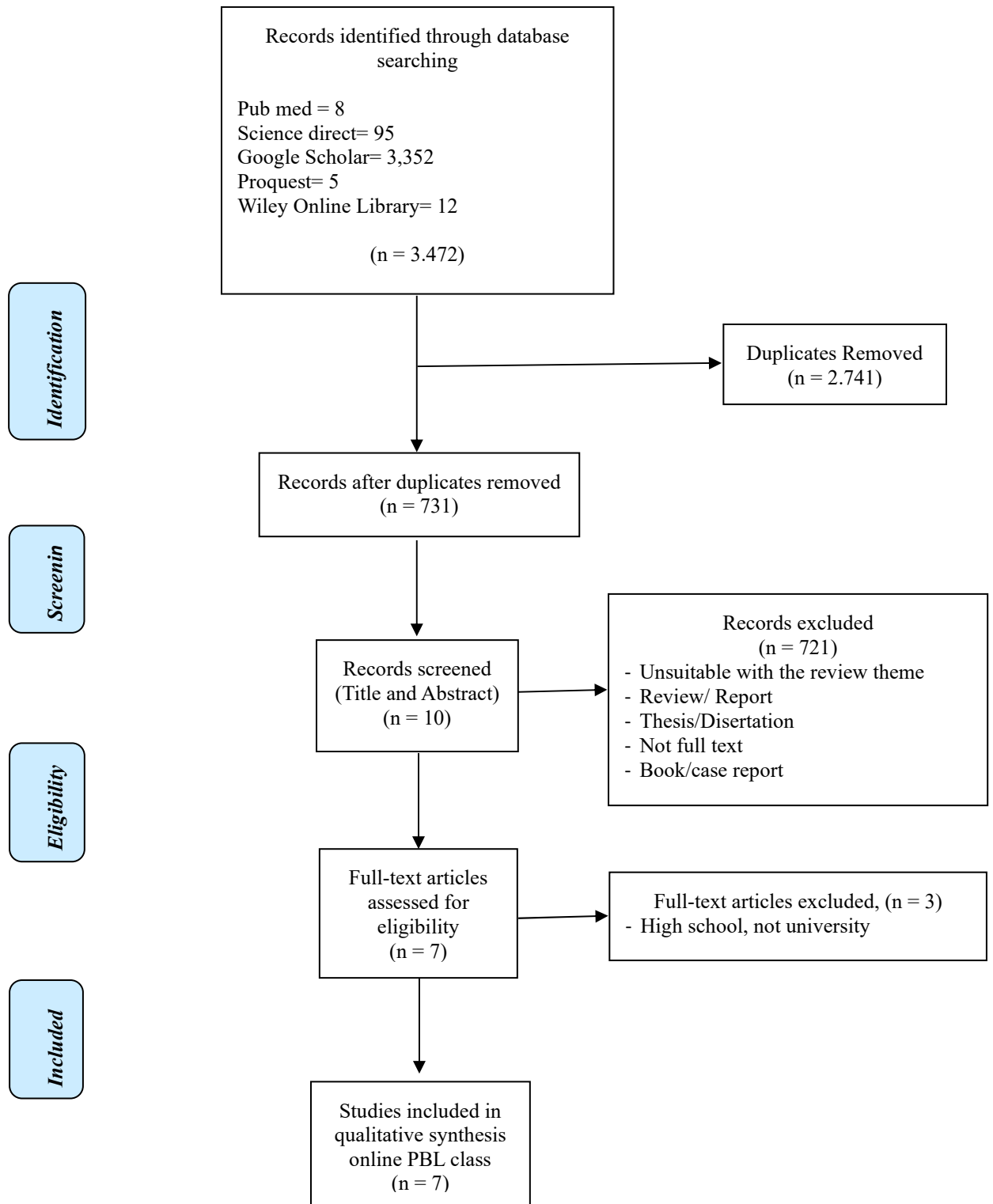
The search returned 1,678 articles; after removing the duplicated articles, 731 articles remained, of which 721 were removed after screening titles and abstracts. The remaining ten articles were reviewed and checked for eligibility, so three articles were excluded. The final results were collected as many as seven articles that met the inclusion criteria.

### *Article Characteristics*

Most of the literature included is in the quantitative type with a Quasy experimental research design of five articles [13,17,18,21,22] and one each for the Randomized Controlled Trial [20], and Research & Development [19]. A total of 654 students were involved in all the studies included in this study. Included articles were published from 2010 to 2021 and conducted in five different countries, including China (n = 3) and one study in Hong Kong, Turkey, Korea, and the USA.

Areas of knowledge for the implementation of Problem-Based Learning (PBL) in online classes include Hematology [17], Dentistry [13], Nursing management [22], problem-solving skills, and communication skills [18], Division of Speech and Hearing Sciences [19], Oncology Nurses [20], bio-pharmaceutics [21].

The educational levels of participants in several articles included in this review consist of clerkship students [13], Post-graduate students [15], undergraduate students, and working nurses [18].



**Figure 1.** PRISMA Flowchart literature search

Author, year, Title	Country	Purpose of the study	Method (Sample, study design)	Online setting	Evaluation strategies	Results	Study Quality
Luo et al., 2021. We-Chat as a Platform for Problem-Based Learning Among Hematological Postgraduates [15]	China	To explore a new pedagogical method called We-Chat-PBL	Quasy experimental, 48 hematological postgraduates	We-chat	Group discussion	Positively impact the learning experience	Good
Zhang et al., 2019. We-Chat as a Platform for Problem-Based Learning in a Dental Practical Clerkship [13]	China	To explore We-Chat-based PBL for students in a dental practical clerkship	72 students in a dental practical clerkship and 10 tutors	We-chat	Periodic and long term evaluation	Increase knowledge and skills, improve the learning process	Good
Ding et al., 2018. Practice and effectiveness of web-based problem-based learning approach in a large class-size system [9]	China	To investigate the effectiveness of web-based PBL teaching pedagogies in large classes.	Quasy-experiment., experiment group 162 taught using a web-based PBL teaching approach, control group 166 taught using conventional teaching methods	We-chat	Questionnaire	Increased self-learning capacity, motivation, self-monitoring, and interpersonal communication	Good
Aslan, 2021. Problem-based learning in live online classes: Learning achievement, problem-solving	Turkey	To investigate the effect of technology supported PBL in a	Quasy experimental, 45 students	Zoom	Questionnaire	Improve student understanding and application of theoretical	Fair



skill, communication skill, and interaction [16]		first aid training through LOC, on students' learning achievement, problem solving-skills, communication skills, and interaction.				knowledge in a large classroom setting	
M.L. Ng et al., 2014. Designing, implementing and evaluating an online problem-based learning (PBL) environment [17]	Hongkong	To design and implement an online learning environment for the PBL curriculum of the Division of Speech and Hearing Sciences at HKU.	R & D. Two groups of third year undergraduate students of the Division of Speech and Hearing Sciences at the University of Hong Kong	The web-based interface	- Self-reported questionnaire	Improve student learning process	Fair
Kim et al., 2014. Effects of an Online Problem-Based Learning Program on Sexual Health Care Competencies Among Oncology Nurses [18]	Korea	To examine the effectiveness of an e-PBL program that offers multimedia scenarios to develop SHC competencies.	RCT, 32 RNs	The e-PBL program	- Sexual Health Care Knowledge Scale - Sexual Health Care Attitude Scale. - Sexual Health Care	Increased knowledge	Good

					Practice Scale. - A questionnaire		
Magboub et al., 2016. Evaluation of in-class and online discussion meetings in a bio-pharmaceutics problem-based learning class [19]	USA	To evaluate faculty-led discussion meetings (with about eight students) conducted face-to-face (in-class) or by synchronous , real-time videoconference (online), in a bio-pharmaceutics course taught in a facilitated problem-based learning (PBL) format.	Quasy experimental, 129 students (in class = 73, online = 56 students)	Google Hangout	- Scoring system, survey, sociograms	Increased availability and acceptance , reduced interactivity.	Good

**Table1.** Critical data extraction from included articles

### *Online settings*

The online class system used is varied, such as We-chat social media used in three studies conducted in China with results showing that this strategy provides an increase in the learning experience, increases student knowledge, and interpersonal communication [13,17,22]. Two studies conducted in the same year, namely 2014 in Hong Kong and Korea, used a web-based interface to

form Adobe Connect and the e-PBL program. In carrying out the study, authors combined several other internet-based communication channels such as e-mail, and social media as a forum to discuss the assigned tasks where it improvises the learning process and can increase students' knowledge [19,20]. Meanwhile, a study in the USA used the Google Hangout application to discuss the tasks of the Problem-Based Learning program; this is considered the most accessible medium to use where this application is available on every gadget or smart phone. Through those media may increased availability and acceptance, but unfortunately reduced interactivity [21]. The application that is currently most often used is "Zoom" Aslan conducted a study that tried to investigate the effect of using this application in the PBL model on the problem-solving skills, communication skills, and interactions of 45 students involved in his studies. *Zoom* PBL improves student understanding and application of theoretical knowledge in a large classroom setting [18].

The entire study was conducted to assess the effect of implementing the PBL method in online classes. Some studies even compare with conventional methods or face-to-face [21]; [20]. Meanwhile, the study conducted by [18] tried to compare the online class with the PBL approach with the online class teacher-based methods. Three studies using We-chat applications in China aimed to assess the effectiveness of online class-based PBL using We-chat, but each has a different field of knowledge for its application [13,17,22].

## **DISCUSSION**

The articles reviewed in this systematic review generally show the implementation of PBL methods in online classes. In some cases, this method can reduce cognitive load and allow students to learn in complex domains [18,20].

The We Chat-based PBL mode conducted by [17] is designed to support postgraduate students' abilities in haematology courses, including those related to clinical reasoning, team skills, and meta-cognition. This online PBL model has succeeded in eliminating the physical and temporal limitations of traditional PBL, as has been implemented so far [17]. Similar results were also

obtained in another study that used We-Chat as a medium in the implementation of PBL, where this method succeeded in removing the physical and temporal limitations of traditional PBL in dental registrars. We-chat is very common and familiar in China, so this application is the primary choice for people to socialize in cyberspace. This method also ensures the time required and quality of PBL, expands the means of acquiring knowledge, and increases efficiency in problem-solving. As a modern pedagogical philosophy, the importance of PBL is increasingly recognized in student learning and innovation in medical education [1]. Many educators have tried to improve traditional PBL by modifying instruction. Therefore, other PBL modes such as tutors PBL, 3C3R Modified PBL, and Hybrid PBL have emerged in PBL teaching [13,23,24]. However, compared to traditional PBL, WeChat-PBL has several advantages that take PBL to a higher level [13,22].

M.L. Ng and colleagues used Adobe Connect to implement online tutorials to embody the Problem-Based Learning model for students. Users, namely students, can open any web browser to connect to Adobe Connect. All PBL sessions ran smoothly, without significant delays in audio or serious interruptions in video transmission. Students stated that Adobe Connect was smooth, easy to install and worked well with their home internet connection. The students agreed that the system met the requirements for online tutorials. The study also concludes that the pedagogical effectiveness associated with online PBL does not differ from traditional PBL for students in later years with the curriculum well integrated into the PBL process. Through online PBL, students enjoy PBL more and save a lot of travel time [19]. Thus, online PBL appears to be the way forward when time and place requirements cannot be met or when weather or other conditions do not allow for regular meetings or the current situation, namely the Covid-19 pandemic.

The e-PBL program that is trying to be developed in Korea shows that this program is very useful, especially for Oncology nurses. Online learning allows participants to interact with each other regardless of time and place restrictions and presents complex data in an accessible way that is fun and easy to learn. This program is highly expected to be integrated into continuing education for nurses. when PBL is delivered in online groups, students can play an active role in solving problems

through the use of case studies and online discussions. Tutors participate in online discussions by contributing questions and comments, and provide timely feedback to encourage collaboration and topic-focused discussion [20].

The challenges of online education include technological capabilities, student acceptance of technology, and the ability of lecturers to adapt to new roles and to acquire new instructional skills [25]. The survey results in research in the USA show that technology is not a barrier for students. However, almost half of the students in the class indicated that they preferred discussion in class to online. Many students get lower online discussion learning scores than in class meetings [5]. PBL discussion meetings may be held online due to the increased availability and acceptance of technology but may lead to reduced interaction and participation. This suggests that online discussions require facilitators to encourage and stimulate student participation and active student-student interaction which may differ from the approach used for face-to-face class discussions [5].

The current reviews corresponds to the findings from other reviews focusing on the effectiveness of DPBL (Digital Problem Based Learning) in improving health professionals' knowledge, skills, attitudes, and satisfaction [1],[26]. These reviews explores more the differentiation between DPBL and traditional PBL [26]. In current review, we found few evidence that show the effectiveness of PBL in virtual environment similar with traditional PBL. Jin & Bridges reviews stated more on the hardware used in PBL, while our review mostly used software or application which commonly can be accessed using android technology in mobile phone.

## **CONCLUSION**

This systematic review shows the implementation of various PBL-based online classroom technologies. Overall, the results for PBL in virtual class include Positively impact the learning experience, Increase knowledge and skills, improve the learning process, Increased self-learning capacity, motivation, self-monitoring, and interpersonal communication, Improve student understanding and application of theoretical knowledge in a large classroom setting, Increased

availability and acceptance, reduced interactivity.

## **LIMITATION**

The systematic preparation of this review cannot be separated from efforts to collect relevant articles completely and comprehensively discussing issues related to the theme of implementing the PBL model in online classes. The author does not collect enough relevant articles due to the accessibility of relevant articles in the database that the author cannot do, besides the language that the author limits to English articles only. In the end, we were unable to carry out further analysis (meta-analysis) because the number of articles included in this study did not meet the requirements (very few).

## **Funding statement**

This research did not receive any specific grant from funding agencies in the public, commercial, or not for profit sectors.

## **Competing interests statement**

There are no competing interests for this study.

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