

# **The Effectiveness of the PBL Teaching Model on the Achievement and Critical Thinking Skills Development of Chinese Undergraduate Students: A Systematic Review**

**Yuxin Lu**  
**Infrastructure University Kuala Lumpur**

**Charanjit Kaur Swaran Singh**  
**Universiti Pendidikan Sultan Idris**  
**Infrastructure University Kuala Lumpur**

*Problem-based learning teaching models is a student-centered teaching model. This paper searched China's largest database, China Knowledge Network, using the Systematic Reviews and Meta-Analyses (PRISMA) guidelines method to search and screen prospective studies on the teaching effectiveness of the PBL teaching model published from 2013 to 2023, and based on the pre-set inclusion/exclusion criteria, a total of 30 papers were selected. The results show that the PBL teaching model effectively improves Chinese undergraduate students' achievement and critical thinking, and therefore, PBL can be implemented in Chinese undergraduate education. However, the use of the PBL teaching model is narrow due to its late start in China, and a more rigorous methodology and mixed-methods design of the studies are needed to improve the transferability of the results.*

*Keywords: problem-based learning teaching model, achievement, critical thinking skill, Chinese undergraduate*

## **INTRODUCTION**

With the rapid development of technology, the classroom is no longer the only channel for acquiring knowledge; students can access a vast amount of knowledge and information through the internet, newspapers, books, etc. In this learning environment, time and space are much less of a constraint on learning, but at the same time, with the amount of complex information available, learners must be able to think more critically and analytically and know how to place the information and ideas available online in real problem-solving and creative situations, to explore, evaluate and think deeply about them, and thus make more informed decisions (Lu, 2021). The problem-based learning (PBL) teaching model has attracted the attention of many educators as a teaching model that focuses on enhancing students' transferable skill. Problem-based learning (PBL) teaching model was first defined by Barrows and Tamblyn and applied in medical education research in the United States. In 1980, Barrows et al. defined PBL as a course and a process. As a course, it involves well-designed problems and requires learners to think critically and solve problems rationally, thereby acquiring knowledge and study abilities. As a process, it requires learners to

discuss problems in small groups after learning independently. The idea of PBL is to integrate the process of learning knowledge into complex, contextualized problems, allowing students to work in groups to acquire knowledge through solving real-life problems, building a complete body of knowledge and developing lifelong learning habits in the process. Barrows believes that the PBL teaching model aims to structure knowledge for use in clinical contexts, Develop an effective clinical reasoning process, Develop effective self-directed learning skills, and increase motivation for learning (Barrows, 1996). Over time, PBL has been defined as a teaching model for teaching and learning. Hmelo-silver, and Borhan argue that PBL is a student-centered teaching model that develops students' problem-solving skills. When students are faced with complex open-ended problems, they need to identify and implement a direction for learning, disambiguate, find the resources they need in the mass of information, learn independently and collaboratively by figuring out what they need to know to solve the problem, and then apply that knowledge to the problem (Borhan et al., 2020). Hmelo-Silver defined the goals of problem-based learning as Constructing flexible knowledge, Developing effective problem-solving skills, Developing life-long learning skills, Being a good collaborator and Becoming intrinsically motivated (Aslan, 2021).

The problem-based teaching model is built by setting up questions, self-learning of students and group discussion; teachers set up course-related and life-relevant problems before the class, and students need to solve these problems through the Internet, books, literature, and other sources before the class, and then students need to discuss these problems with their group members in the classroom and get the final conclusions. The PBL teaching model instructs teachers to guide the students to solve problems, cases, or scenarios independently (Barrows, 1996). It requires students to learn by solving problems, which are not just problems but motivators for learning. Not only do students gain knowledge through problem-solving, but they also learn the ideas and methods of problem-solving. In solving problems, students will continue to identify and ask new questions, facilitating their understanding of knowledge (Huang et al., 2022). In this process, the instructor presents problematic cases or scenarios to the students, who are required to learn on their own and then return to their groups to discuss and refine the knowledge they have gained. Unlike the LBL teaching model, the initial goal of the PBL model is to improve students' ability to solve clinical problems. To ensure effectiveness, the teacher should be involved as little as possible so that students can learn independently and dynamically (Fan et al., 2017). The PBL teaching model requires students to be the main subject of classroom teaching and to participate in the teaching process, which can give full play to students' initiative and creativity, promote their true understanding and mastery of knowledge and develop various abilities. Students have to go through the process of questioning, judging, comparing, selecting, analyzing, synthesising and summarising knowledge to obtain problem-solving through various ways of thinking and cognition, which is a process in which students gradually acquire critical thinking and problem-solving skills.

Currently in China, some scholars have tried to introduce PBL teaching model at the undergraduate education level. Still, the implementation of PBL teaching model requires higher teaching environment and hardware equipment, as well as more time and effort from both teachers and students. It is especially demanding on the quality of students (Yang et al., 2014). Whether the application of PBL at the undergraduate level can improve students' achievement and critical thinking has not been consistently evaluated by various researches, therefore, this study reviews the effectiveness of the application of PBL at the undergraduate level in China, to provide a reference for the reform of teaching and learn at the undergraduate in China.

## **PURPOSE AND OBJECTIVE**

This study reviewed several studies on PBL in China undergraduate education. The objectives of this research were as follows:

- (1) Is the use of PBL teaching model in Chinese undergraduate education effective in promoting the student' achievement?
- (2) Is the use of PBL teaching model in Chinese undergraduate education effective in promoting the students' critical thinking development?

## RESEARCH METHOD

This study aims to identify and assess the existing literature on problem-based learning teaching model and use it to draw conclusions about the effectiveness of the PBL teaching model on academic achievement and critical thinking among Chinese undergraduate students. This systematic literature review uses the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines method. Preparing articles using the PRISMA methodology involves three preparatory stages: identification, screening and inclusion.

In the identification stage, since the scope of the study is China, 12 August 2023, the researcher used google scholar and China National Knowledge Infrastructure (CNKI), the largest database in China, to conduct the first stage of literature identification, covering the period from 2013 to 2023 years. In the CNKI, this study used keywords to search for the article title, abstract, and keywords. The search keywords were “problem-based learning,” & “higher education,” & “achievement” and “problem-based learning” & “higher education” & “critical thinking”. The language of the retrieved articles was restricted to Chinese and English, and the time period was restricted to 2013 to 2023 years.

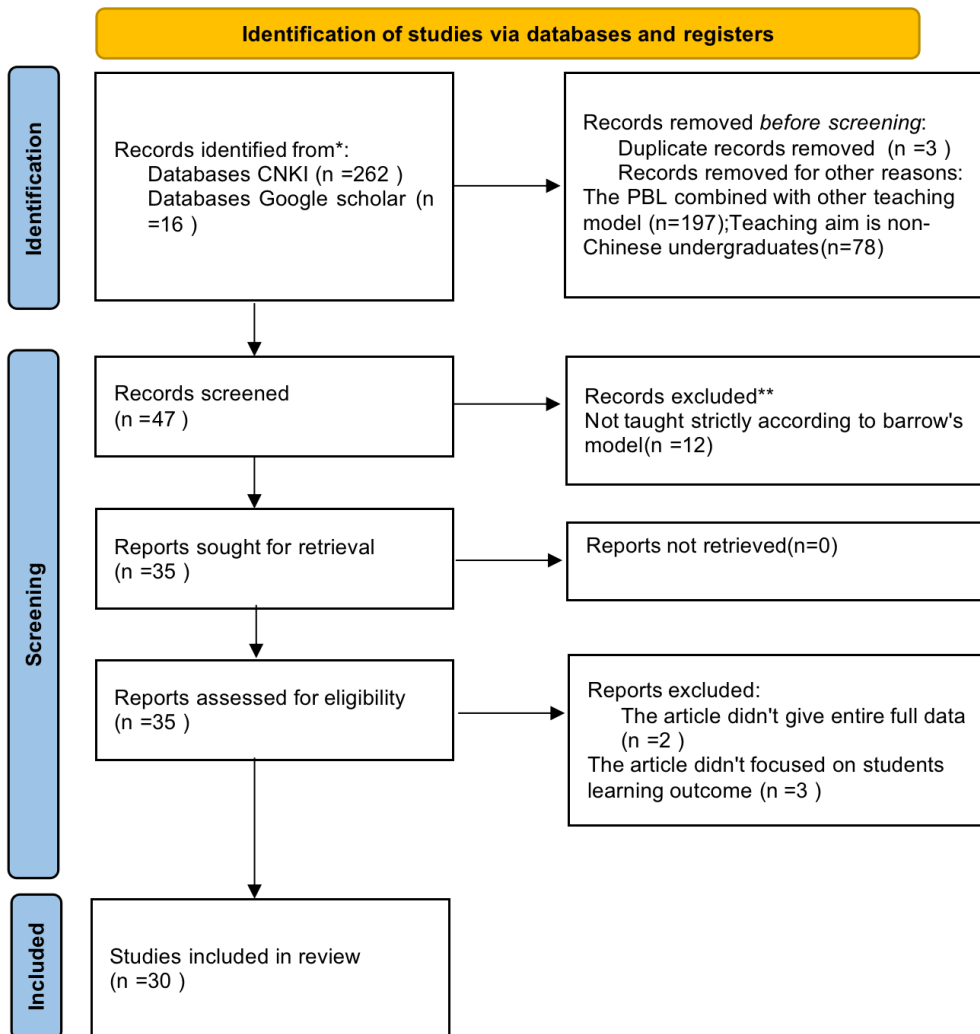
The second stage is screening. The screening stage had two parts; firstly, the inclusion and exclusion criteria of the literature were identified, which were:

1. Inclusion criteria: (1) the teaching target is Chinese undergraduate students (2) the evaluation of teaching effectiveness indicators are complete measures, including basic theory scores (3) Considering that other teaching model may have had an impact on the results, the selected studies had to strictly follow the PBL teaching model set by Barrow
2. Exclusion criteria: (1) Other teaching models that may have an impact on the results of the study were applied. (2) The teaching target is not Chinese undergraduate students (3) No measurement data (4) The teaching is not strictly according to the PBL teaching model set by Barrow

The second screening stage was used to check that all articles that passed the identification stage met the criteria. At this stage, articles were reassessed for suitability for analysis based on the title and abstract. Two themes were identified in this study: the effects of the PBL teaching model on Chinese undergraduate students' achievement and critical thinking. Eligible outcomes were broadly categorized as follows: the study of changes in students' achievement after using PBL teaching model; comparing changes in students' achievement after using PBL teaching model versus other teaching models; changes in students' critical thinking after using PBL teaching model versus other teaching models; and changes in students' critical thinking after using PBL teaching model. Finally, confirm that the article meets the requirements by reading the full text. Data were collected for this study in the following areas: author, year, source of publication, time of intervention, method of intervention, and method of measuring student achievement, and method of measuring student critical thinking.

Our review utilized the PRISMA guidelines to find as many suitable studies as possible. We expanded our search terms and databases, but we chose to limit our search to two databases known for their quality and contribution to research to ensure the rigor and quality of the papers included in our assessment. The researchers emphasized the quality of the selected articles over the scope of the study; however, due to the scope of the study, all of the publications we chose originated from China, and most of the studies were within the scope of medical research due to the late arrival of PBL teaching model in China.

**FIGURE 1**  
**THE WORKFLOW OF IDENTIFICATION OF STUDENTS VIA**  
**DATABASES AND REGISTERS**



**FINDING**

30 papers were ultimately chosen for study based on the research methodology, as shown in Table 1.

**TABLE 1**  
**SUMMARY OF SELECTED LITERATURE**

Title	Author(s)	Year	DOI
Exploration of PBL teaching in respiratory medicine based on the development of “critical thinking skills”.	Duan MinChao ; Li QiuMing et al	2021	DOI:10.19296/j.cnki.1008-2409.2021-06-038
The effect of PBL pedagogy on critical thinking and self-directed learning skills of undergraduate nursing interns	Chen ShuJun, Gao FuRong et al	2022	DOI:CNKI:SUN:ZOGU.0.2022-10-059
An Experimental Study on the Effectiveness of College English PBL Model Teaching on Cultivating Undergraduate Students' Critical Thinking Skills	Li Yingxin; Shi YuTing	2020	DOI:CNKI:SUN:GJTA.0.2020-07-011
Cultivating students' critical thinking skills using PBL teaching methods in histoembryology laboratory teaching	Wang XiYan; Pan XiaoYan et al	2018	DOI:CNKI:SUN:ZDYX.0.2018-10-061
Impact of PBL clinical teaching method on critical thinking in ENT oriented traineeships	Zhao XingQuan; Zhong Qu et al	2018	DOI:10.3969/j.issn.1674-9308.2018.01.007
An Empirical Study of Problem-Based Learning (PBL) Pedagogy to Promote College Students' Learning Efficacy	Wang Tao; Li ChenHong	2019	DOI:CNKI:SUN:DXJY.0.2019-02-004
Application of PBL teaching method in teaching livestock microbiology course	Yao Min; Peng BenYing et al	2019	DOI : 10. 3969/j. issn. 0517—6611. 2019. 13. 083
Practice and Reflection on PBL Teaching of Diagnostic Thinking in Clinical Pathology to Medical Students Based on Barrows' Model	Liu YiFei;Ni HaoSheng et al	2019	DOI:10.19767/j.cnki.32-1412.2019.03.039
The use of PBL teaching method in teaching community nursing	Wang HaoQing; Yang YuRong et al	2018	DOI:10.16281/j.cnki.jocml.2018.a3.009
A study on the effect of PBL teaching method in ophthalmology clinical teaching	Zhang DaWei; Kong FanHong	2016	DOI:CNKI:SUN: SXYY.0.2016-10-038
Application Effect of PBL Teaching Method in Clinical Internship Teaching of Thoracic Surgery	Yang Shengrong & Zhu Bing	2023	DOI:CNKI:SUN:JXUY.0.2023-09-022

Title	Author(s)	Year	DOI
Application Status and Countermeasures of Standardized PBL in Human Anatomy Teaching	Quan Yuanyuan & Liang Yi	2023	DOI:CNKI:SUN:ZGBZ.0.2023-08-069
Effect Evaluation of PBL Teaching Method in Health Statistics Teaching Practice of Preventive Medicine Major.	Wen Jing, Li Jiangping et al.	2023	DOI:CNKI:SUN:JXUY.0.2023-07-008
Application and Effect Evaluation of PBL Teaching Method in Geriatric Medicine Teaching	Dai Shuiping, Yu Chunyan et al.	2023	DOI:CNKI:SUN:JXUY.0.2023-04-010
Exploration of PBL Teaching Model in Pathological Diagnosis of Nephrotic Syndrome.	Zeng Chunyan	2022	DOI:CNKI:SUN:FLBR.0.2022-06-024
Application of PBL Teaching Method in Standardized Nursing Teaching of Respiratory Medicine	Shi Chanchan, Zhu Chong et al.	2022	DOI:CNKI:SUN:ZGBZ.0.2022-24-063
Value of PBL Teaching Method Combined with Laparoscopic Techniques in Hepatobiliary Surgery Residency Training	Zhang Cheng	2023	DOI:CNKI:SUN:JXUY.0.2023-01-021
Effect of Case-Based PBL Teaching Method on Clinical Teaching of Traditional Chinese Medicine Orthopedics	Cao Baoyuan	2022	DOI:CNKI:SUN:ZZYY.0.2022-23-014
Influence of Clinical PBL Teaching Method in Nephrology on Trainees' Critical Thinking Ability	Guo Jiahong, Wei Hua Et al.	2022	DOI:CNKI:SUN:JXUY.0.2022-18-019
Exploratory Study on Case-Based PBL Teaching Method in General Surgery for Cultivating Students' Critical Thinking Ability	Dai Youguo, Yan Zhijun Et al.	2017	DOI:CNKI:SUN:JYJY.0.2017-02-028
The Influence of Clinical PBL Teaching in Nephrology on Students' Critical Thinking Abilities	Wu Yu	2016	DOI:CNKI:SUN:JXUY.0.2016-33-007

Title	Author(s)	Year	DOI
The Impact of PBL Teaching Model on Critical Thinking Abilities of Clinical Medical Students	Jiang Wenxi, Du Xiaoqin Et al.	2016	DOI:CNKI:SUN:ZHDZ.0.2016-09-047
Analysis of the Application Effect of PBL Teaching Method in “Medical Statistics” Teaching and Its Influence on Students’ Critical Thinking Abilities	Zhou Zewen, Qi Guangzi, Et al.	2016	DOI:CNKI:SUN:YJMZ.0.2016-01-045
Application and Effect Evaluation of PBL Teaching Method in Cultivating Critical Thinking Abilities of Nursing Undergraduates	Deng Wenfang, Ren Boxu Et al.	2015	DOI:CNKI:SUN:JTHS.0.2015-36-003
Research on the Application of PBL Teaching Method in “Obstetrics” Teaching.	Cao Yongjun, Wang Hongyun Et al.	2017	DOI:CNKI:SUN:TJFN.0.2017-03-002
Analysis of the Effect of PBL in Medical Imaging Technology Professional Internship Teaching	Li Yanrong, Deng Xiaoguang Et al.	2021	DOI:CNKI:SUN:JXUY.0.2021-30-010
Application of PBL Teaching Method and Critical Thinking in Clinical Teaching of Thoracic Surgery for Medical Undergraduates	Zhao Jinbo, Chen Zhao Et al.	2014	DOI:10.13241/j.cnki.pmb.2014.32.039
The Impact of PBL Teaching Model in Orthopedic Traumatology on Critical Thinking Abilities of Clinical Medical Students	Zhang Yongxing, Zhou Dong, Et al.	2014	DOI:CNKI:SUN:ZOGU.0.2014-10-051
Observation of the Effect of PBL Teaching Method in Oncology Undergraduate Education	Han Xia, Chen Yinghai Et al.	2022	DOI:CNKI:SUN:JXUY.0.2022-18-011
Cultivation of Students’ Critical Thinking Abilities through PBL Teaching Method in Experimental Teaching.	Qin Haihong, Ge Wei et al.	2013	DOI:10.16791/j.cnki.sjg.2013.06.037

After a four-stage systematic literature review analysis, eligible articles were identified and 30 publications were found that were relevant to assessing student achievement or critical thinking following the use of PBL teaching model. Based on this review, the use of standardised test results to assess student

achievement and the use of The Chinese version of the California Critical Thinking Scale to assess student critical thinking were the most commonly used assessment techniques. Each of these 30 publications uses mixed methods to study, with sample sizes ranging from a minimum of 15 to a maximum of 229 students. In all of the included studies, the subjects were Chinese undergraduate students. Most of the subject fields involved were in medical higher education, with only one applying the PBL teaching model to English language teaching, one to logistics management major and one to biology teaching, which may be related to the fact that PBL teaching model originally originated in medical education (Li et al., 2020)(Yao et al., 2019)(Guo & Xu., 2022). In all studies, the PBL teaching model was implemented for varying lengths, ranging from a single session to a course lasting a full year, up to a maximum of 12 months. According to the literature selection principles, the PBL teaching model for all courses strictly followed Barrow's conceptual model.

Of the 22 studies included, where students' achievement was assessed based on academic performance, 21 studies compared changes in student performance before and after using the PBL teaching model and comparing PBL with other instructional methods (usually with the LBL teaching model). 19 of these studies found that students who implemented the PBL teaching model had significantly higher test scores when comparing test scores between PBL and with groups that received only traditional curriculum (Li et al., 2021) (Chen et al., 2022) (Wang et al., 2019) (Yao et al., 2019) (Liu et al., 2019) (Wang et al., 2018) (Qin et al., 2013) (Han et al., 2022) (Zhou et al., 2016) (Jiang et al., 2016) (Wu, 2016) (Guo et al., 2022) (Cao, 2022) (Zhang, 2023) (Shi et al., 2022) (Zeng, 2022) (Dai et al., 2023) (Quan & Liang, 2023) (Yang&Zhu,2023). One study compared the distribution of score bands of students in the PBL group with those in the LBL group and showed that students who were taught using the PBL teaching model did not have significantly different scores on objective questions from those who were taught using the LBL teaching model, but had significantly higher overall and subjective scores than those in the LBL group (Wen et al., 2023). One study compared the score bands of students after using the PBL method with the LBL method and found that there were fewer students in the lower score bands using the PBL method, as well as significantly higher mean scores than the LBL method, again suggesting that the PBL method improves students' academic performance (Guo & Xu, 2023). However, in one study, it was shown that students who implemented the PBL teaching model compared to those who implemented the LBL teaching model did not have a significant difference in the two groups despite improved test scores. This study concluded that teaching model was not related to students' academic level is not relevant (Zhang & Kong, 2016).

20 of the 30 included studies assessed the impact of the PBL teaching model on Chinese undergraduate students' critical thinking. The Chinese version of the California Critical Thinking Scale, adapted by Mei-Chi Peng, was used to measure critical thinking. The California Critical Thinking Scale, based on Facione's conceptual classification, will measure critical thinking into seven items: truth-seeking, open-mindedness, analytical ability, systematization, self-confidence in critical thinking, intellectual curiosity, and cognitive maturity. It has good validity and reliability and has been followed and promoted by countries around the world (Peng et al., 2004).

Before and after using the PBL teaching model, the researchers measured the students' critical thinking, and at the end of the experiment, the scale scores were compared before and after using the PBL teaching model as well as with those of the students who had used the LBL teaching model to verify whether the PBL teaching model could improve the student's critical thinking. One study found that after using PBL teaching model, students had higher open-mindedness in critical thinking, analytical ability, systematization ability, and self-confidence in critical thinking than the students who used LBL teaching model. At the same time, there was no significant change in truth-seeking, inquisitiveness, and cognitive maturity (Deng et al., 2015). Two studies found that, except for the latitude of truth-seeking, the rest of the six latitudes were improved after using the PBL teaching model (Zhou et al., 2016) (Dai et al., 2017). Two studies found that in the four dimensions of truth-seeking, open-mindedness, analytical ability, and intellectual curiosity, students' scores were higher after the use of the PBL teaching model than before the use of the PBL teaching model, and the scores of three dimensions, such as the ability to systematize, self-confidence in critical thinking, and cognitive maturity, did not show a statistically significant difference when compared with the pre-testing and control groups (Chen et al., 2022) (Duan et al., 2021); one study showed that the three



dimensions of analytical ability, intellectual curiosity and cognitive maturity were higher in students using the PBL teaching model than in students using the LBL teaching model and that there was no difference between the scores of the 4 dimensions of truth-seeking, open-mindedness, systematization ability and self-confidence in critical thinking (Wang et al., 2018); 12 studies found that the students' scores on the critical thinking scale were higher than those of students before the use of PBL teaching model in all dimensions (Wang et al.,2018) (Wang et al.,2019) (Li et al., 2020) (Zhang & Kong, 2016) (Qin et al., 2013) (Zhang et al., 2014) (Zhao et al., 2014) (Li et al.,2021) (Zhou et al.,2016) (Wu,2016) (Guo et al., 2022) (Cao, 2022); One study showed that students' open-mindedness and curiosity were higher than those in the LBL group after the use of the PBL teaching model, and there were no differences in other dimensions (Zhao et al., 2018). However, regardless of whether there were significant differences in the dimensions of critical thinking, vast studies showed that the overall critical thinking scores were significantly higher than before using the PBL teaching model or higher than using the LBL teaching model. This indicates that students' critical thinking was significantly improved after the use of the PBL teaching model. However, unlike the vast majority of findings, Cao's study found that there was no significant increase in students' scores on the critical thinking questionnaire before and after the use of the PBL teaching model and between the (Cao et al., 2017).

## DISCUSSION

### **The Effect of the PBL Teaching Model on Chinese Undergraduate Students' Achievement**

22 studies assessed the effectiveness of the PBL teaching model in Chinese Undergraduate Students' achievement. Most of the included studies compared PBL with the traditional lecture-based learning (LBL) teaching model to verify the impact of the PBL teaching model on students' achievement by comparing the changes in students' scores on standardized tests after implementing different teaching models. Wen Jing's study found that, compared with students who used the LBL teaching model in the examination, students who used the PBL teaching model did not score significantly differently from those who used the LBL teaching model in the objective questions, but their overall scores and subjective scores were significantly higher than those of students in the LBL group, which suggests that the reason why the PBL teaching model improves the performance of the students is most likely due to the enhancement of the student's analytical and problem-solving ability, which leads to the improvement of performance(Wen et al., 2023).Guo Jinchao's study found that when analyzed in terms of the scores range, the classes using the PBL teaching model had more balanced scores with fewer students in the low-scoring bands, while the classes using the LBL teaching model had more low-scoring students. In terms of accurate rate of exam, students in the PBL class performed significantly better than those in the LBL class, suggesting that the PBL teaching model may be more beneficial to students with poorer fundamentals when it comes to improving their grades, this may be because the PBL teaching model is student-centered. The teaching requires students to take the initiative to discover problems and continuously search for information and conduct discussions among group members to obtain solutions to problems, which stimulates students' interest in learning in the process. (Guo & Xu,2022). Except that, 20 studies found that PBL teaching model can effectively improve the achievement of Chinese undergraduate students, but one of them held a different view. Dawei Zhang's study found that there was no significant difference in theoretical achievement between students using PBL and LBL teaching models, which may be because students familiar with teacher-centered methods were unable to adapt when exposed to student-centered PBL teaching model, leading to poorer results (Zhang & Kong, 2016). In addition, in most of the studies, the students were exposed to the PBL teaching model for the first time. Apart from the fact that the need for some adaptation time to the PBL teaching model may have had a poorer impact on the results, it is also possible that the use of the new teaching model may have led to better results because the students and the instructor, due to their curiosity, had an increased interest in learning and spent more time in the course. Time on task has been shown to improve performance (Singh&Manjaly,2022). it is conceivable that students perform better in PBL simply because more class time is devoted to the topic. Finally, the difficulty of applying a randomized double-blind control method

to the instructional research process and the fact that some of the research literature included did not describe randomized groupings in detail may have led to selection bias.

### **The Impact of The PBL Teaching Model on Critical Thinking of Chinese Undergraduate Students**

As a student-centered teaching model, the PBL teaching model focuses on guiding students to participate in small groups and learn by using solutions to ill-defined open-ended problems (Liu, 2012). This process is designed to promote analytical reasoning, problem-solving, and collaborative learning, all of which are components of critical thinking. Thus, theoretically, the PBL teaching model is considered a possible practical approach to developing critical thinking due to the overlapping parts between PBL and critical thinking. From the results of the included studies analyzed in this review, it is clear that the PBL teaching model is effective in improving students' critical thinking. The methodology adopted by most of the studies that addressed students' critical thinking was to compare the change in students' scores on the critical thinking scale before and after the use of the PBL teaching model, as well as to compare the scores on the scale of the students who used the PBL and the LBL teaching model. The scale adopted for all the studies was the Chinese version of the California Critical Thinking Scale adapted by Mei-Chi Peng, which is based on Facione's conceptual classification and will divide critical thinking into seven items to be measured, which are truth-seeking, open-mindedness, analytical ability, systematization, self-confidence in critical thinking, intellectual curiosity, and cognitive maturity (Peng et al., 2004). It has good reliability and validity and has been used and promoted by countries around the world. The results showed that in terms of total critical scale thinking scores, 99% of the studies found a significant increase in the total critical thinking scale scores of the students who used the PBL teaching method. Still, Cao Yongjun's study found that there was no significant increase in the critical thinking questionnaire scores of the students before and after the use of the PBL teaching model. This may be because the intervention period for applying PBL in this study was short, only three classes, which is far less than other studies. The short number of class only allowed students to familiarise themselves with the PBL teaching model initially, whereas acquiring critical thinking skills requires long-term and continuous education.

Currently, based on the literature included, the vast majority of researchers believe that using PBL effectively improves students' critical thinking. However, improving the total scores on the critical thinking scale does not mean that every latitude score that makes up critical thinking is significantly improved with the use of PBL pedagogy. Overall, the four latitudes of intellectual curiosity, open-mindedness, analytical ability and cognitive maturity were generally perceived to be improved. In comparison, the ability to improve the three latitudes of truth-seeking, systematization and self-confidence in critical thinking was controversial. In the PBL teaching model, teachers need to set up problems and situations according to teaching materials, and students use the Internet or books to explore the problems, sift out the required information in a large amount of information, and explore the solution to the problem by exercising their own initiative, which is a form of simulation for the establishment of critical thinking, and thus invariably prompts students to establish critical thinking. In this process, the construction of the problem stimulates the students' desire for knowledge, while the process of searching for the answer enhances the students' cognition of the multi-faceted nature of things so that the students can treat things objectively, emphasize the reasons, search for evidence and solve the problems. After using PBL pedagogy, eight studies showed that the latitude of searching for the truth was not improved, and six studies showed that systematic ability and critical thinking self-confidence were not improved. The reason for this may be because PBL as a new teaching mode, and students can not immediately adapt to the new teaching method, in the adaptation period of the new teaching method, students feel overwhelmed, which affects the students' critical thinking self-confidence, so it is presumed that the short-term PBL teaching is not effective in improving the students' truth-seeking, critical thinking self-confidence, and systematization ability. In addition, analytical and systematization abilities are limited by students' cognitive ability and education level, so the promotion is limited. To further improve their analytical ability, students need to be exposed to more problematic situations and exercise their ability to cope with problems. To improve their systematization ability, students need to have good and solid theoretical knowledge and a deep and thorough understanding of what they have learned.

## CONCLUSION

This review provides a comprehensive understanding of the use of the PBL teaching model in Chinese undergraduate education and its impact on student achievement and critical thinking. Based on this analysis, the PBL teaching model may improve achievement and critical thinking in Chinese undergraduates, but more rigorous methodological and mixed-methods design studies are needed to improve the transferability of results and to focus on the longer-term impacts of the PBL model of teaching and learning on student learning outcomes and competencies.

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