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RESEARCH ARTICLE

A systematic review on the effectiveness of case-based learning (CBL) in the undergraduate pharmacy programme

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Abstract

Background: Efforts to innovate teaching methods have led to case-based learning (CBL) as a response to traditional lecture limitations. CBL, also known as case study teaching, involves students actively achieving learning objectives with facilitator guidance. Based on literature search, no systematic review has evaluated studies on CBL effectiveness in pharmacy curricula. **Objective:** This systematic review was performed to assess CBL's impact on student satisfaction, knowledge acquisition, and lecturers' perspectives for undergraduate pharmacy students. **Methods:** A research question was developed for the review using the PICO framework. Keywords and synonyms were used in Boolean searches within PubMed and ERIC databases. Inclusion criteria encompassed full-text articles from 2011 to 2021, focused on undergraduate pharmacy education, and published in English. Retrieved articles were screened and analysed using ATLAS.ti 9.0 for coding and conceptual framework generation. **Results:** Twelve studies were included, all assessing knowledge gain, student satisfaction, general perception, and lecturers' perspectives on CBL. Consensus indicated CBL is particularly suited for case-heavy subjects like clinical or primary care settings. **Conclusion:** CBL is an effective teaching-learning method for certain subjects and should be integrated into the curriculum of undergraduate pharmacy.

Introduction

Case-based learning (CBL), also known as case study teaching and case method learning, is a pedagogical method of delivering a set of learning objectives through student-driven discovery and is mostly guided by a facilitator. However, this definition is very general as it changes with the field it is employed in, as well as the type of case employed (Thistlethwaite *et al.*, 2012). This very variation of the definition of CBL leaves much to be questioned relative to how it should be conducted, what a case used for CBL would be for the different professions or even its effectiveness in teaching. CBL is an active teaching method that could benefit medical and pharmacy students (Tsekhmister, 2023).

In CBL, students are encouraged to develop skills in communication and critical thinking while receiving feedback on participation and preparation from their peers and facilitators to improve learning through a case-based approach (Donkin *et al.*, 2023; Tsekhmister, 2023). It is perceived to be more engaging and effective in enhancing student learning and satisfaction than traditional didactic lectures (Rathinavelu *et al.*, 2023), and allows for a greater association between theory and practice (Meira *et al.*, 2022). The format is versatile, and students can focus on one simple case scenario that requires one or multiple sessions. The facilitator is ideally a content expert and corrects misconceptions or redirects students to the focused learning objectives (Burgess *et al.*, 2021).

During the COVID-19 pandemic, some institutions conducted CBL online (Donkin *et al.*, 2023). The

utilisation of online CBL was extensive and encompassed a range of platforms for facilitating online interaction and access to resources. Communication methods varied from video-based group discussions with online support (e.g. Zoom) to utilising platforms like Google Classroom stream, blogs, and instant messaging. However, there is little information on applying pedagogical frameworks and using learning theories to design and deliver online content. It is crucial to incorporate a constructivist, learner-centred, and social learning approach into the online learning experience (Donkin *et al*., 2023).

While there is available literature that evaluates the effectiveness of CBL on a large scale in the curriculum of major healthcare professions, especially in medicine and nursing, no conclusive systematic review was done on studies evaluating CBL effectiveness related to pharmacy students. Das and colleagues in 2021 conducted a cross-sectional study involving 54 faculties from various allied sciences. The study found that 96% of the faculties agreed that CBL is a better way to develop concepts, and nearly 81% agreed that more learning could be done with less effort. In a study evaluating the effectiveness of CBL among 90 second-year medical students studying pharmacology, a statistically significant difference was found in the post-test scores of the CBL group compared to the conventional didactic teaching group, with the CBL group achieving higher scores ($p < 0.001$). This indicated that the medical students who underwent CBL had gained more knowledge and a better understanding of the pharmacology topics than those taught through the conventional method (Jain *et al*., 2023).

Another cross-sectional study was conducted on 148 second-year pharmacy students in one of the pharmacy schools in Malaysia. The study used the Dundee Ready Education Environment Measure (DREEM) inventory to primarily determine the students' perception. The results indicated an overall positive perception of the learning environment, with an average DREEM score of 137.29 out of 200 (Abdullah *et al*., 2023). To date, no systematic review has been identified to assess the effectiveness of the CBL that is about to be incorporated into pharmacy teaching and learning activities. Thus, this systematic review aimed to assess the effectiveness of CBL with regard to pharmacy student satisfaction, knowledge gained, critical thinking, and skills, as well as to evaluate CBL as an alternative teaching-learning method for undergraduate pharmacy students.

The outcomes derived from this systematic review could potentially assist policymakers and pharmacy curriculum developers in acquiring a more holistic comprehension of the feasibility of incorporating this approach into pharmacy curricula's teaching and learning process.

Methods

The data collection method used was primarily document search and review via e-databases and sources other than databases and registries. The data was then analysed digitally with ATLAS.ti 9.0. After the results were obtained, a conceptual framework was constructed.

Sampling

PRISMA

Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) was used as an evidence-based minimum set of items for the systematic reviews (Shamseer *et al.*, 2015).

Resources

Several databases were considered for the literature search; PubMed and Education Resources Information Centre (ERIC) were used to collect publications for specifically education-related papers. PubMed is a free engine to search primarily MEDLINE databases of references and resources on life sciences and biomedical topics. The United States National Library of Medicine maintains it. ERIC, on the other hand, is an online digital library of education research and information mainly used by educators and is used to provide information and a library to improve teaching, learning, and educational decision-making. The two databases for this evaluation were selected based on multiple factors. In addition to their user-friendly interface, both databases are easily accessible at no cost and hold significance for interdisciplinary purposes, such as educational interventions in healthcare.

Inclusion and exclusion criteria

Several inclusion and exclusion criteria were identified for this review. For inclusion criteria, full-text articles published between 2011 and 2021, studies related to pharmacy education at the undergraduate level and articles published in English. The exclusion criteria include articles that are conference full proceedings and previous systematic reviews published on similar topics.

Data collection

Keyword development

The research question was formulated, and keywords and synonyms were identified using the Patient or Problem, Intervention or Exposure, Comparison or Control, and Outcome(s) (PICO) framework. The PICO framework was chosen because it encompasses all the essential elements needed for a focused question (Levy Library Guides: Evidence-Based Medicine: The PICO Framework, n.d.). However, it is worth noting that adjustments and tweaks had to be made to the actual search engine to deliver satisfactory and good search returns. Table I shows the formulated research question in the PICO framework and all identified synonyms. Boolean operators were employed in this search, such as using "*OR*" and "*AND*" operators to filter articles.

Table I: The PICO framework and synonyms

Framework	Emphasis	Keywords	Synonyms
Population	Undergraduate pharmacy teaching and learning	Undergraduate pharmacy	pharmacy degree, pharmacy education, BPharm, (undergraduate) PharmD, (undergraduate) MPharm, pharmacy degree, Bachelor of Science (Pharmacy)
		Teaching & learning	Education, instructing, tutoring
Intervention	Case-based learning	-	Case method, case study, case teaching, case-based approach, case-oriented problem solving, case-based problem solving,
Comparison	Didactic lectures	-	conventional teaching, traditional teaching, classroom teaching, lectures, hall teaching
Outcome	Effectiveness	Knowledge	Cognition, cognitive skills, topic comprehension, proficiency, understanding
		Communication skills	Interpersonal communication, interprofessional communication, soft skills
		Critical thinking	Critical thinking, analytical thinking, evaluative, comprehensive

Screening of articles

Articles obtained from PubMed and ERIC databases underwent abstract screening to assess their suitability for inclusion. Those deemed relevant were subsequently downloaded and subjected to a more comprehensive review to ascertain their eligibility for final analysis. The final analysis ultimately included only those that met the eligibility criteria.

Systematic review process

The PRISMA framework representing the systematic review process is shown in Figure 1.

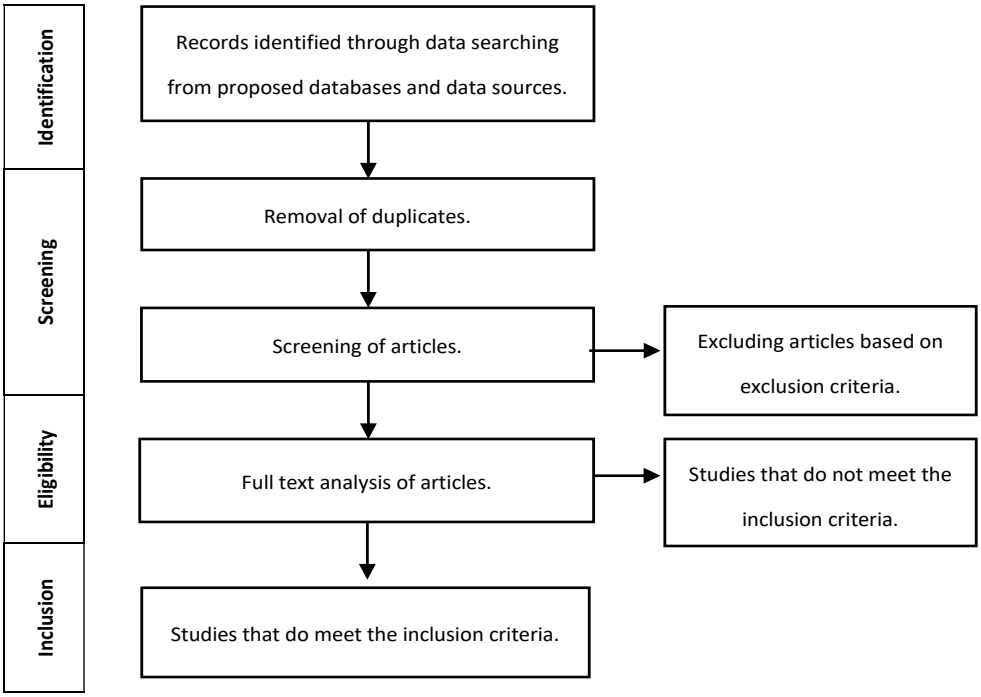

Figure 1: The complete PRISMA framework for inclusion of articles in this systematic review

Results

Descriptive statistics

A total of 12 articles were included for final review. The descriptive analysis of the selected papers for this review is detailed in Table II – Table IV.

Table II: Articles retrieved and included in the systematic review

Database	Number of retrieved articles (n=134)	Number of included articles (n=12)
PubMed	97	10
ERIC	38	2

Table III: Summary of included studies in ascending order by year of publication (N = 12)

Author	Year of publication	Country	Participants	Study design	Main findings
Ferreri & O'Connor	2013	United States	126 students	Cross-sectional survey	Knowledge gained • CBL was associated with an increase in the number of students achieving higher grades, particularly in the A and B ranges after one year ($p < 0.002$) and two years ($p < 0.001$). Improvement in skills • Students indicated improved verbal communication skills, the ability to tackle and resolve unfamiliar problems, and the ability to work effectively as part of a team. • They also reported enhanced understanding and ability to work with individuals from diverse cultures. Lecturers' perspective of CBL as an alternative • Faculty members had a positive perception of the redesigned course using CBL.
Ha & Lopez	2014	United States	97 Students	Cross-sectional survey	Knowledge gained • The mean average score for the pretest (without CBL) was 6.9 ± 1.5, and the mean average score for the post-test (with CBL) was 9.4 ± 0.88 ($p < 0.001$), indicating that students gained health literacy knowledge and skills through the CBL exercise. Student satisfaction/perception • students felt the case-based exercise was effective in teaching the defined learning objectives and that they would be able to apply the information and skills learned in practice
Wong *et al.*	2014	United States	101 students	Cross-sectional survey	Knowledge gained • The mean examination scores of the intervention group were significantly higher than the mean examination scores of the control for the cardiac arrhythmia classes in pharmacology (with 89.6 ± 2.0% vs 56.8 ± 2.2%, respectively) and therapeutics (89.2 ± 1.4% vs 73.7 ± 2.1%, respectively). Student satisfaction/perception • Overall feedback was positive, suggesting that students saw value in the teaching method to enhance their learning experience.
Khanova *et al.*	2015	United States	171 students	Cross-sectional survey	Student satisfaction/perception • While students appreciated the interactive, CBL during class time, they felt unprepared for these activities without an instructor-led review of key concepts beforehand.
Nasir *et al.*	2016	UK	329 students (139 pharmacy)	Quasi-experimental study	Student satisfaction/perception • Between 93-99% of students overall strongly agreed or agreed with statements supporting the benefits of CBL in IPL.
Tatachar & Kominski	2017	United States	84 Students	Quasi-experimental study	Knowledge gained • The students in the question creation group did perform slightly better on two of the five questions on the block exam, but these differences did not reach statistical significance. Student satisfaction/perception

Author	Year of publication	Country	Participants	Study design	Main findings
					• The students in the question creation group reported significantly more positive perceptions than the traditional case-based group in terms of enjoyment and interest in the subject matter.
Das *et al.*	2018	United States	221 Students	Cross-sectional survey	Student satisfaction/perception • Approximately 88% of P2 students and 92% of P3 students responded positively to the introduction of case studies in the medicinal chemistry curriculum, indicating that they felt it enhanced their learning and appreciation for the subject. • A total of 41.2% found the case studies useful, highlighting the impact of this teaching approach on their learning experience Lecturers' perspective of CBL as an alternative • They supported the use of CBL as an effective teaching method that aligns with the evolving healthcare system and the clinical trajectory of pharmacists.
Pearson *et al.*	2018	United States	95 Students	Cross-sectional survey	Knowledge gained • Aggregate mean postformal thinking score was 51.98 in the pre-survey and 56.26 in the post-survey ($p < 0.05$). Student satisfaction/perception • Most respondents agreed or strongly agreed that the activity helped them learn, was better than traditional lectures, and helped them prepare for material that would be on the exam.
Jacob *et al.*	2019	Malaysia, Australia	10 Lecturers	Qualitative study	Lecturers' perspective of CBL as an alternative • Educators identified several advantages of CBL, such as enhancing the applicability of knowledge to real-world pharmacy practice, fostering higher-order thinking skills, and developing teamwork and communication abilities. Student satisfaction/perception • There was a consensus that CBL should be introduced in the first year of the pharmacy program, with a scaffolded approach that progressively increases the complexity of cases as students advance.
Singh *et al.*	2020	South Africa	6 Lecturers	Qualitative study	Lecturers' perspective of CBL as an alternative • Pharmacy educators view CBL as a strategy that has the potential to develop graduate attributes, particularly in strengthening knowledge and skills (Domains 1 and 2).
Lee *et al.*	2020	United States	72 Students	Cross-sectional survey	Lecturers' perspective of CBL as an alternative • Expressed satisfaction with the changes that led to a better learning experience. Student satisfaction/perception • Students responded positively to the modified case studies courses, showing a preference for the new design over the previous one. • Most students indicated that they preferred a more objective subjective, objective, assessment, plan (SOAP) note rubric with detailed descriptions on point allocation, small group discussion within a classroom and faculty-facilitated case review in group discussion.
Dodd *et al.*	2020	United States	271 students	Cross-sectional survey	Knowledge gained • CBL resulted in significantly higher scores for the domains of perception of pharmacist roles (+1.22), ability to identify public health issues (+1.60), pharmacist impact in disease outcomes; HIV (+0.65), DM (+0.42), and AL (+0.70). Student satisfaction/perception • There was a significant increase in the domain of perceiving pharmacists as role models in public health (MODEL), with a change score of +1.50.

Table IV: Major strengths and weaknesses of included studies (N = 12)

Author	Year of publication	Strengths	Weaknesses
Ferreri & O'Connor	2013	• Improved Student Performance: The results showed a clear improvement in student grades and learning outcomes, indicating the effectiveness of the redesigned course format. • Faculty and Student Perceptions: The inclusion of faculty and student perspectives provided a rich understanding of the impact of the course redesign on both teaching and learning experiences.	• Cohort Differences: The use of different cohorts of students may have introduced variability in the results, as differences between classes cannot be fully accounted for. • Generalisability: The study was conducted at a specific institution, and the results may not be generalisable to other educational settings or institutions without further research.
Ha & Lopez	2014	• Objective Assessment: The study used pre-test and post-test scores to objectively measure the effectiveness of case-based learning in teaching pharmacy students' health literacy concepts and skills. This quantitative approach provided a clear indication of the knowledge gained. • Student Feedback: The inclusion of student evaluations provided subjective feedback on the effectiveness of the CBL exercise, complementing the objective assessment with insights into student perceptions and experiences.	• Lack of Validation: The pre-test and post-test examinations were not validated tools, which may raise questions about the reliability and generalisability of the results. • Potential Bias: Students knew that the health literacy case exercise was part of a study, which could have influenced their performance on the pretest, post-test, and SOAP note writing.
Wong *et al.*	2014	• Comparative Design: The study uses a comparative design by examining the performance of students taught with the flipped method against a control group taught with traditional methods. • Student Feedback: The inclusion of student feedback through a survey provides insights into the perceived value of the flipped teaching method, offering a more comprehensive understanding of its impact.	• Potential Bias: The intervention group had a slightly higher pharmacy GPA than the control group, which could introduce a potential bias. • Faculty Perspectives: The study does not include the perspectives of faculty members.
Khanova *et al.*	2015	• Mixed-Methods Approach: The study used a combination of quantitative and qualitative methods, including pre- and post-course surveys and open-ended questions, which allowed for a comprehensive understanding of student perceptions. • Specificity to Pharmacy Education: By focusing on a pharmacotherapy course within pharmacy education, the study provides insights that are relevant and detailed for the specific context of health professions education.	• Student Preferences: The study acknowledged that student preferences for traditional lectures could have influenced the results, potentially biasing the findings against the flipped classroom model. • Lack of Comparative Data: The study did not include a comparison group that experienced a traditional lecture format, which would have allowed for a more direct comparison of the two teaching methods.
Nasir *et al.*	2016	• Positive Student Feedback: The overwhelming positive feedback from students suggests that the sessions were well-received and perceived as beneficial. • Feasibility: The study demonstrated that it is feasible to deliver small-group IPL sessions to many students with minimal staff, which is a strength in terms of scalability and resource efficiency.	• Voluntary Participation: The sessions were not compulsory for most students, which could have led to self-selection bias, where only students with a pre-existing interest in IPL participated. • Evaluation Design: The study used a quasi-experimental post-intervention design, which may not be as robust as a randomized controlled trial in terms of establishing causality.
Tatachar & Kominski	2017	• Random Assignment: Students were randomly assigned to either the traditional case-based application exercise or the student question creation exercise, which helps to control for confounding variables and ensures a more equitable distribution of student abilities across groups. • Direct Comparison: By directly comparing two different active learning methods, the study provides insight into which approach may be more beneficial for student learning and engagement.	• Subjectivity of Perceptions: While the student question creation group reported more positive perceptions, these are subjective measures and may not directly correlate with objective learning gains or long-term retention of knowledge. • Potential for Bias: The study acknowledges the inherent difficulties in designing controlled educational research, which could introduce bias or affect the validity of the results.

Author	Year of publication	Strengths	Weaknesses
Das *et al.*	2018	• Curriculum Relevance: The study addresses the relevance of medicinal chemistry in the PharmD curriculum, which is an important consideration for curriculum design and improvement. • Faculty and Pharmacist Support: The study indicates that faculty and pharmacists support the use of case-based studies, suggesting a collaborative effort in enhancing pharmacy education.	• Qualitative Analysis of Comments: While the study attempted a qualitative analysis of student comments, the depth and rigour of this analysis are not clear. A more systematic approach to qualitative data analysis could have provided richer insights into student perceptions. • Lack of Control Group: The study does not appear to have a control group that did not receive case-based instruction, which would have allowed for a more direct comparison of the effectiveness of the case-based approach.
Pearson *et al.*	2018	• Student Perception Data: The study gathers data on students' perceptions of the activity, which can provide insights into how well the activity is received and its perceived benefits for learning and exam preparation. • Pilot Study: As a pilot, the study serves as an initial exploration of the effectiveness of fishbowl activities in pharmacy education, which can inform future, larger-scale studies.	• Small Sample Size: The study includes a relatively small number of participants (95 students), which may limit the generalisability of the findings. • Lack of Control Group: There is no control group for comparison, therefore, the study cannot definitively attribute any observed changes to the fishbowl activity alone.
Jacob *et al.*	2019	• Qualitative Approach: The use of one-on-one interviews allowed for in-depth exploration of educators' perceptions and experiences with CBL. • Thematic Analysis: The study employed thematic analysis to identify key themes and patterns in the data, which helped to organise and make sense of the complex information gathered from the interviews	• Small Sample Size: With only ten participants, the study's findings may not be generalisable to a broader population of pharmacy educators. • Lack of Student Perspective: The study focuses solely on educators' perceptions and does not include the views of the students, who are the end recipients of CBL.
Singh *et al.*	2020	• Qualitative Approach: The use of reflective interviews and document analysis allows for a deep exploration of pharmacy educators' views on graduate attributes and CBL. • Practical Implications: The research provides practical suggestions for enhancing CBL, such as using emotionally rich cases and integrating CBL with inter-professional education, which can be directly applied to improve pharmacy education.	• Potential for Bias: The reliance on self-reported views of educators may introduce bias, as educators' perceptions of the effectiveness of CBL might not fully align with actual student outcomes. • Lack of Student Perspective: The study focuses on educators' views and does not include the perspectives of students, which could provide a more balanced understanding of the effectiveness of CBL in developing graduate attributes.
Lee *et al.*	2020	• High Response Rate: The 80% response rate from students for the survey suggests that the study had a good level of participation, which strengthens the validity of the findings. • Faculty Collaboration: Involving the faculty in the design and implementation of the changes likely contributed to the success of the new course format, as their insights and experiences were integral to the modification process.	• Limited Generalisability: The study was conducted at a specific institution with a particular pharmacy curriculum, which may limit the generalizability of the findings to other programs or institutions. • Potential for Bias: The study relies on self-reported data from students and faculty, which could be subject to response bias, where participants may provide answers, they perceive as desirable rather than their true experiences.
Dodd *et al.*	2020	• Pre- and Post-Survey Design: The use of pre- and post-activity surveys allowed for a direct comparison of students' perceptions and confidence before and after the CBL exercise. • High Response Rate: With 271 out of 336 students completing both surveys, the response rate of 80.6% is quite high, which strengthens the validity of the findings.	• Lack of Control Group: The study did not include a control group of students who did not participate in the CBL exercise • Potential Confounding Variables: Factors such as the teaching method, instructor quality, or other concurrent educational activities may have influenced the results and were not controlled for in the study.

The process of study selection using the PRISMA framework is shown in Figure 2. Overall, the types of CBL introduced in the various institutions, as in the studies, are very similar where a certain case is

introduced to the students, and they would be there to evaluate the case and determine the problems and the proposed solutions to the problems.

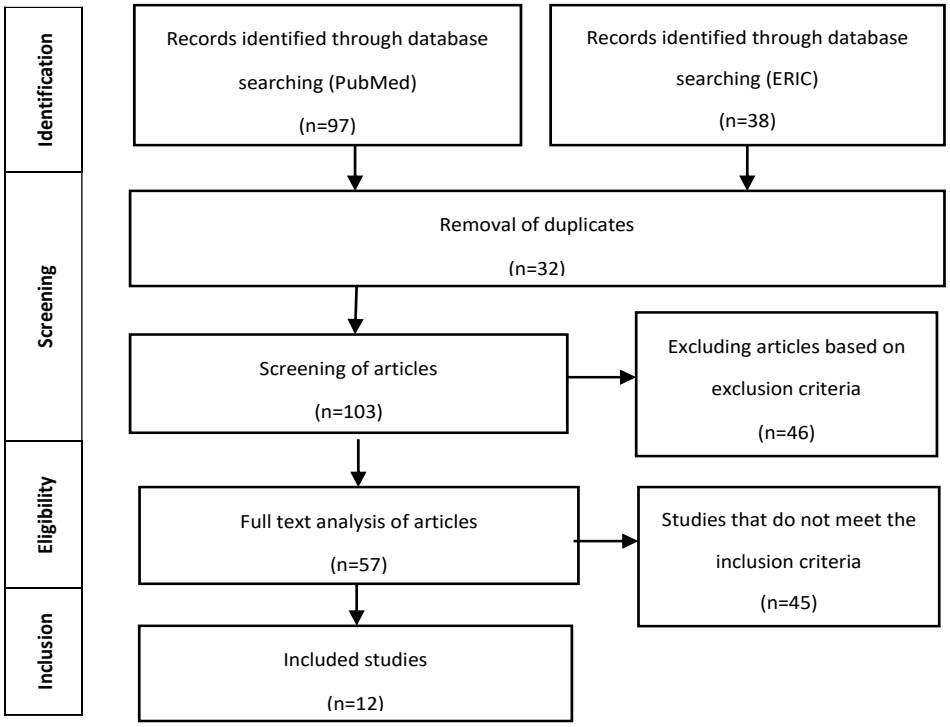

Figure 2: Selection process of studies using the PRISMA framework

They combine previously learnt knowledge and skills and can then integrate them in the process of solving the cases. It is also noted that most of the cases were based on actual cases or cases from literature, so it mirrors what it would be in the real world without making them unrealistic in actual cases. This helps students understand what a typical case would be and would also be able to apply this in a real setting. The summary of all included studies (N = 12) is shown in Table III.

Study conceptual framework

The framework in Figure 3 was constructed from identifying themes in the selected articles and was built to represent the relationships between the articles visually.

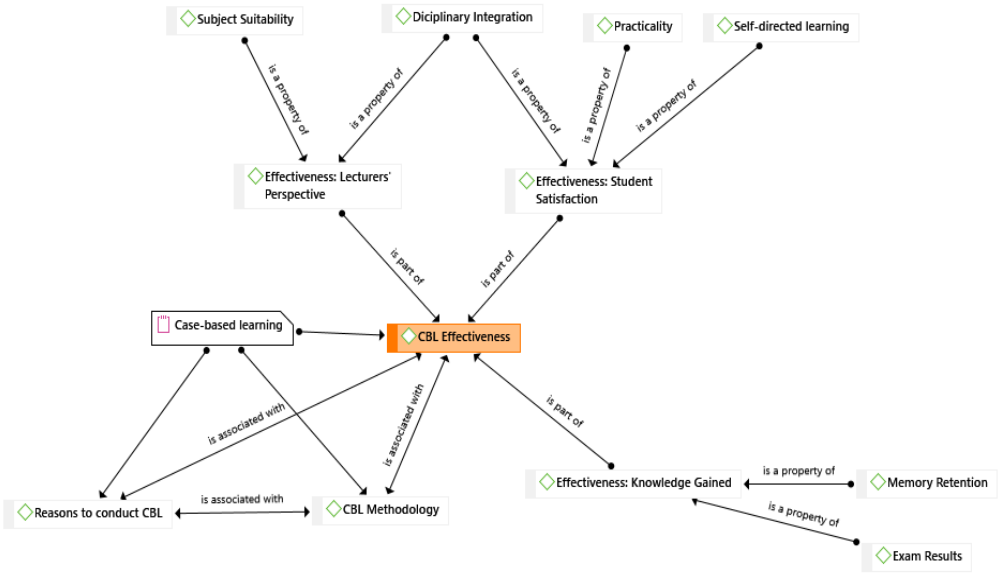

Figure 3: Conceptual framework of the systematic review

Discussion

Knowledge gained

One measure of effectiveness is the knowledge gained from using CBL in teaching activities. This aligns with Kirkpatrick's model of training or education effectiveness at its highest level, relating to results (Thistlethwaite *et al.*, 2012). Kirkpatrick's model is a framework for evaluating the effectiveness of training and education programs, categorising outcomes into four levels, namely reaction, learning, behaviour, and results. It assesses how participants react to the training, what they learn from it, how they apply the learning in their jobs, and the impact of this application on organisational performance (Kirkpatrick & Kirkpatrick, 2007).

In a study conducted by Ferreri & O'Connor (2013), it was found that the redesign of the course to a small-group, CBL format was associated with an increase in the number of students achieving higher grades, particularly in the A and B ranges, and a decrease in the number of students receiving lower grades (C and F). This trend suggests that the new course format was more effective in facilitating student learning and academic performance. This was further supported by a controlled study conducted by Wong and colleagues in 2014 involving 204 first-year pharmacy students. The study found that the mean examination score for the intervention group (flipped class using CBL) was significantly higher compared to the control group in pharmacology ($p < 0.001$) and therapeutic courses ($p < 0.001$) but not in basic science courses ($p = 0.12$).

Another study by Singh and colleagues in 2020 also found that CBL is effective in developing Domain 1 (knowledge) and Domain 2 (possessing and displaying skills) but is less effective in developing Domain 3 (identity construction and roles and responsibilities). A more recent study showed an improvised approach using CBL. The study compared traditional lecture-based learning with CBL in a therapeutic drug monitoring (TDM) course within an integrated pharmacy curriculum at Campbell University. The study supports the benefit of CBL in clinical pharmacokinetics and indicates that CBL, combined with virtual patients and a simulated electronic health record (EHR), can be an effective approach to teaching TDM, leading to successful preparation for experiential rotations and improved knowledge retention in pharmacy students (Bowers *et al.*, 2022). The findings are supported by another study that also found the benefit of CBL in improving pharmacy students' knowledge of pharmacokinetics (Meira *et al.*, 2022).

Student satisfaction and general perception

A major theme across all the journal articles was student satisfaction in terms of their enjoyment of the subject and their perception of the difficulty and ease of understanding the subject or topic introduced through the cases that were given. Student satisfaction was primarily evaluated through surveys, with additional context provided by interviews in certain journal articles. In a study by Ferreri & O'Connor (2013), it was found that despite the significant improvement in student grades and learning outcomes, there was an increase in negative comments on course evaluations after the course redesign. This suggests that while the CBL approach was effective in enhancing student performance, it may not have been as well-received in terms of student satisfaction. Tatachar & Kominski (2017) also found that student satisfaction, as

measured by the online survey, was higher in the student question creation group compared to the CBL group.

In contrast, Wong and colleagues in 2014 found overall positive student feedback regarding the effectiveness of the flipped teaching method conducted using CBL in enhancing learning and understanding. This was further supported by a study done by Das and colleagues in 2018 that found 88% of second-year students and 92% of third-year students reported that the introduction of CBL enhanced their learning and appreciation for the subject. This level of satisfaction suggests that students find the CBL approach to be an effective and engaging method for learning medicinal chemistry. A newer study conducted by Lee and colleagues in 2020 also found high student satisfaction with the modified CBL courses.

Lecturers' perspective

For an effective learning experience, the lecturer's perspective should also be considered, as they are the ones with the pedagogical knowledge and skills to conduct and construct meaningful cases for students to use in their studies. From this review, five out of 12 articles reported lecturers' perception of CBL as an alternative method to teaching pharmacy subjects. In these five articles, lecturers generally have a positive perception of incorporating CBL as a teaching methodology and that they support its use. They, however, also expressed some concerns related to time constraints in preparing necessary materials for the CBL (Ferreri & O'Connor, 2013; Das *et al*., 2018; Lee *et al*., 2020; Singh *et al*., 2020) and that it may not fit every subject (Jacob *et al*., 2019). While it can help to turn abstract concepts from lectures into concrete skills, it does not consider content-heavy subjects such as pharmaceutics, where it must be done hands-on rather than in a simulated or virtual case. This shows that CBL does have its place in effective learning but is more suited for case-related subjects such as therapeutics or clinical pharmacy. This revelation comes as there is no true one-size-fits-all for pharmacy subjects and in due diligence in detailing what works best for which subject or discipline is required to effectively deliver academic material.

Conclusion

This study explores the effectiveness of CBL via three domains, that is quantifiable test scores, student perception and lecturer or educator perspective on its effectiveness. This review found that CBL can increase students' mean test scores. However, CBL was shown to probably be more suitable for case-heavy subjects such as clinical or primary care settings and less suitable for subjects such as pharmaceutical technology. Regarding student satisfaction, this review found that overall, students are satisfied with the redesigned courses using CBL. However, it is important to take into account the appropriateness of the courses when transitioning to a CBL approach in education. In this review, the lecturers or educators perceived CBL as a valuable method for enhancing learning, particularly in subjects that are case-oriented, like therapeutics or clinical pharmacy.

In conclusion, integrating more CBL into the pharmacy curriculum can greatly enhance the planning and designing of the curriculum. By incorporating real-life cases that highlight the latest discoveries and advancements in the field, pharmacy educators can provide students with a more practical and hands-on approach to learning. This not only stimulates critical thinking and problem-solving skills but also helps students develop important teamwork and communication skills.

Furthermore, CBL can bridge the gap between theory and practice, allowing students to see the direct application of their knowledge and skills in real-world scenarios. With that being stated, this systematic review is constrained by the limited number of studies it encompasses. Therefore, additional reviews are necessary that incorporate a greater number of studies with strong methodologies to provide a more comprehensive understanding of the benefits of CBL in pharmacy education.

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Conflict of interest

The authors declare no conflict of interest.

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