



DEVELOPING CLINICAL REASONING IN MEDICAL STUDENTS USING PBL: AN OUTPATIENT PEDIATRICS EXAMPLE

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ABSTRACT

This study explores the effectiveness of the Problem-Based Learning (PBL) model in developing clinical reasoning competence among medical students, with a specific focus on outpatient pediatrics. PBL enhances critical thinking, promotes self-directed learning, and integrates basic and clinical sciences through authentic clinical scenarios. Key components such as small group discussions, tutor guidance, feedback, reflection, and longitudinal curriculum design significantly contribute to the development of diagnostic skills and decision-making abilities. The results indicate that PBL is a powerful educational approach to bridge the gap between theoretical knowledge and clinical practice.

Introduction.

The Problem-Based Learning (PBL) model enhances clinical reasoning competence in medical students through several key components. Firstly, PBL fosters critical thinking and problem-solving skills by engaging students in authentic patient scenarios, which encourages them to apply theoretical knowledge to practical situations[1–3]. This approach is particularly effective in improving clinical thinking ability, as evidenced by higher post-test scores in PBL groups compared to control groups[1]. The integration of clinical pharmacology into PBL further enhances prescribing competency by improving knowledge retention and understanding of pharmacological concepts, which are crucial for safe and effective prescribing[4]. Additionally, the use of argumentation with concept maps during PBL sessions has been shown to positively affect the development of clinical reasoning skills, as it encourages students to construct and evaluate arguments based on clinical cases[5]. The incorporation of self-directed learning and literature review within PBL sessions also contributes to the development of clinical reasoning by promoting lifelong learning habits and enhancing students' ability to synthesize information from various sources[1,6]. Furthermore, the use of structured scenarios and expert tutors in PBL sessions provides a supportive learning environment that facilitates the application of knowledge to clinical practice[7,8]. The implementation of brief PBL experiences in traditional curricula has also been found to significantly enhance students' clinical competence during their initial clinical clerkships, indicating the model's effectiveness in bridging the gap between pre-clinical and clinical education[9]. Overall, the PBL model's emphasis on active learning, critical thinking, and real-world application makes it a powerful tool for developing clinical reasoning competence in medical students.

Small Group Discussions and Collaborative Learning

One of the cornerstone components of PBL is the use of small group discussions. These discussions facilitate collaborative learning, where students engage in sharing knowledge, generating hypotheses, and solving problems together. This collaborative environment mimics the teamwork often required in clinical settings, allowing students to refine their communication and interpersonal skills while developing their clinical reasoning abilities [10,11].

- **Role of Tutors in Group Dynamics:** Tutors play a critical role in guiding these discussions. Effective tutors not only provide subject-matter expertise but also create an environment conducive to open dialogue and idea exchange. Their ability to express concepts in a student-centered manner and provide timely feedback significantly enhances the learning experience [12,13].
- **Activation of Prior Knowledge:** Small group discussions encourage students to activate their prior knowledge, which is essential for building upon existing cognitive frameworks. This activation process, coupled with opportunities for elaboration, facilitates deeper understanding and long-term retention of clinical concepts [11].

Self-Directed Learning and Autonomous Study

PBL inherently promotes self-directed learning, where students take responsibility for their own education. This component is particularly beneficial for developing clinical reasoning skills, as it encourages students to explore diverse learning resources and engage in independent study [6,14].

- **Linking Theory to Practice:** Self-directed learning in PBL helps students connect theoretical knowledge with practical clinical scenarios. For example, students are often required to identify learning issues during group discussions and pursue these topics independently, fostering a deeper understanding of the subject matter [1,3].
- **Development of Lifelong Learning Skills:** The emphasis on self-directed learning prepares students for the demands of lifelong learning in the medical profession. This skill is critical for maintaining clinical competence in a rapidly evolving field [13,15].

Integration of Basic and Clinical Sciences

PBL curricula often integrate basic sciences (e.g., anatomy, physiology) with clinical sciences (e.g., pathology, pharmacology) to create a holistic learning experience. This integration is vital for developing clinical reasoning skills, as it mirrors the way clinicians approach patient care [4,16].

- **Illness Scripts and Knowledge Networks:** The integration of basic and clinical sciences helps students develop "illness scripts," which are mental frameworks that organize knowledge around specific clinical conditions. These scripts enable students to approach diagnoses systematically and efficiently [16, p. 215,17].
- **Longitudinal Curriculum Design:** Some studies highlight the importance of a longitudinal approach to PBL, where clinical reasoning skills are developed progressively over the course of the curriculum. This ensures that students build upon their knowledge and skills in a structured and incremental manner [18,19].

Feedback and Reflection

Feedback and reflection are integral components of the PBL model. These elements allow students to critically evaluate their own reasoning processes and identify areas for improvement [13,20].

- **Timely and Constructive Feedback:** The use of virtual patients and online Clinical Reasoning Guides provides immediate feedback to students, enabling them to assess the accuracy of their diagnoses and the appropriateness of their diagnostic pathways [21,22].
- **Deliberate Reflection:** Instructional strategies such as deliberate reflection encourage students to think critically about their own thought processes and decision-making. This metacognitive approach enhances the development of clinical reasoning skills by fostering self-awareness and introspection [17].

Longitudinal and Spiral Curriculum Design

A longitudinal and spiral approach to PBL ensures that clinical reasoning skills are developed and reinforced over time. This design allows students to revisit concepts in increasing complexity, solidifying their understanding and application of clinical reasoning[18,19].

- **Early Introduction of Clinical Reasoning:** Introducing clinical reasoning concepts early in the curriculum helps students develop a strong foundation for more advanced learning. Studies have shown that early exposure to PBL improves diagnostic accuracy and reduces the time required to process clinical cases[16,19].
- **Progressive Development of Skills:** The spiral curriculum ensures that each phase of learning builds upon the previous one, gradually increasing the complexity of cases and the depth of reasoning required. This approach aligns with the natural progression of clinical reasoning development in medical students[17,18].

Role of Tutors and Facilitators

The effectiveness of PBL is heavily influenced by the role of tutors and facilitators. Their expertise, teaching style, and ability to guide discussions significantly impact the quality of learning outcomes [12,13].

- **Cognitive and Social Congruence:** Tutors who demonstrate both subject-matter expertise and the ability to communicate effectively with students create a supportive learning environment. This balance of cognitive and social congruence is essential for fostering engagement and collaboration in small group settings [12].
- **Faculty Development:** To maximize the effectiveness of PBL, tutors require training in facilitation skills. Faculty development programs that focus on fostering active learning and clinical reasoning are critical for ensuring the success of PBL initiatives[17,18].

Use of Virtual Patients and Simulations

The incorporation of virtual patients and simulations into PBL curricula has emerged as a powerful tool for enhancing clinical reasoning skills. These tools provide students with realistic and interactive learning experiences that simulate real-world clinical scenarios[21,22].

- **Multimedia and Interactive Learning:** Virtual patients often incorporate multimedia elements such as images, videos, and audio recordings, creating an immersive learning environment. These features enhance student engagement and provide a more comprehensive understanding of clinical cases [21].
- **Assessment of Diagnostic Pathways:** Virtual patients allow for the assessment of not only the final diagnosis but also the diagnostic pathway taken by the student. This feature helps identify gaps in knowledge and reasoning, enabling targeted feedback and improvement[21,22].

Hybrid PBL Models

Hybrid PBL models, which combine traditional PBL with other instructional strategies, have shown promise in enhancing clinical reasoning skills. These models leverage the strengths of both approaches to create a more robust learning experience[17,23].

- **Integration with Coaching Psychology:** The integration of coaching psychology into PBL facilitates the development of self-directed learning and reflection. This approach encourages students to take ownership of their learning and develop a growth mindset, which is essential for clinical reasoning[13].
- **Blended Learning Approaches:** Hybrid models often incorporate online learning tools, such as Clinical Reasoning Guides, to supplement traditional PBL sessions. These tools provide additional support for students, reinforcing their learning and clinical reasoning abilities[20,21].

Assessment and Evaluation Strategies

The assessment strategies used in PBL are designed to evaluate not only the accuracy of diagnoses but also the reasoning processes underlying them. This approach ensures that

students are held accountable for both their knowledge and their ability to apply it in clinical contexts[21,22].

- **Formative and Summative Assessments:** PBL curricula often employ a combination of formative and summative assessments. Formative assessments provide ongoing feedback to students, while summative assessments evaluate their overall competence at the end of a module or course[17,18].
- **Evaluation of Diagnostic Pathways:** The assessment of diagnostic pathways, as seen in virtual patient simulations, helps identify areas where students may need additional support or review. This detailed feedback is invaluable for refining clinical reasoning skills[21,22].

Cultural and Community-Oriented Approaches

PBL curricula that incorporate cultural and community-oriented approaches ensure that students are prepared to address the diverse needs of patients in real-world settings. This component is particularly important for developing clinically reasoning skills that are applicable across different patient populations.

- **Community-Based Learning:** PBL cases often focus on common health problems within the community, ensuring that students are well-prepared to address the needs of the population they will serve. This approach also fosters a sense of social responsibility and cultural competence[18,24].
- **Global Health Perspectives:** Incorporating global health perspectives into PBL curricula broadens students' understanding of diverse healthcare challenges and enhances their ability to reason through complex clinical scenarios in varied settings[18].

Encouraging Metacognition and Reflective Practice

Metacognition and reflective practice are essential for the development of clinical reasoning skills. PBL encourages students to think about their own thinking and reflect on their learning experiences, fostering a deeper understanding of clinical concepts and their application.

- **Self-Explanation and Reflection:** Instructional strategies such as self-explanation and deliberate reflection encourage students to articulate their thought processes and evaluate their own reasoning. These strategies enhance metacognitive awareness and improve the accuracy of clinical diagnoses[17].
- **Peer Feedback and Discussion:** Collaborative learning environments in PBL provide opportunities for students to receive feedback from peers and engage in reflective discussions. This process helps students identify biases, challenge assumptions, and refine their clinical reasoning skills[10,11].

Incorporation of Real Patient Contacts

Incorporating real patient contacts into PBL curricula provides students with authentic learning experiences that enhance their clinical reasoning skills. These experiences allow students to apply theoretical knowledge in practical settings, bridging the gap between classroom learning and clinical practice.

- **Development of Illness Scripts:** Exposure to real patients helps students develop illness scripts, which are mental frameworks that organize knowledge around specific clinical conditions. These scripts enable students to approach diagnoses systematically and efficiently.
- **Transfer of Knowledge:** Real patient contacts facilitate the transfer of knowledge from the classroom to the clinical setting, ensuring that students can apply their learning in real-world scenarios. This transfer is critical for the development of clinical reasoning competence[16].

Focus on Error Reduction and Patient Safety

PBL curricula often emphasize the importance of error reduction and patient safety in clinical reasoning. This focus helps students develop a mindset that prioritizes safe and effective patient care[18,19].

- **Learning from Mistakes:** PBL encourages students to reflect on errors and near misses, using these experiences as opportunities for growth. This approach fosters a culture of safety and accountability, which is essential for clinical reasoning in high-stakes environments.
- **Risk Management and Decision-Making:** By simulating complex clinical scenarios, PBL helps students develop the decision-making skills necessary to manage risks and minimize errors. These skills are critical for navigating the challenges of real-world clinical practice[18,19].

Use of Concept Mapping and Knowledge Organization

The use of concept mapping and knowledge organization strategies in PBL helps students structure their knowledge and develop a coherent understanding of clinical concepts. These strategies are particularly useful for visual learners and for organizing complex information.

- **Clinical Reasoning Maps:** Clinical Reasoning Mapping Exercises (CREsME) are a valuable tool for visualizing the relationships between different components of a clinical case. These maps help students identify patterns, prioritize information, and develop a systematic approach to diagnosis.
- **Enhancing Knowledge Retention:** By organizing knowledge into structured frameworks, students are better able to retain and recall information. This structured approach also facilitates the application of knowledge in clinical settings, enhancing clinical reasoning competence[17].

Incorporation of Pathophysiology and Biomedical Sciences

The integration of pathophysiology and biomedical sciences into PBL curricula ensures that students develop a strong foundation in the underlying mechanisms of disease. This knowledge is essential for developing accurate and efficient clinical reasoning skills.

- **Linking Biomedical and Clinical Knowledge:** PBL encourages students to link biomedical concepts with clinical findings, fostering a deeper understanding of the pathophysiological basis of disease. This integration is critical for developing illness scripts and improving diagnostic accuracy.
- **Application of Basic Sciences:** By applying basic sciences to clinical cases, students develop the ability to reason through complex diagnostic dilemmas. This application is a key component of clinical reasoning and is essential for competent patient care[16,19].

Focus on Cost-Effective and Appropriate Diagnostic Testing

PBL curricula often emphasize the importance of cost-effective and appropriate diagnostic testing in clinical reasoning[25]. This focus helps students develop a mindset that balances diagnostic accuracy with resource utilization.

- **Diagnostic Pathway Analysis:** Virtual patient simulations and other PBL tools allow for the analysis of diagnostic pathways, including the appropriateness and sequencing of tests. This analysis helps students identify unnecessary procedures and develop more efficient diagnostic strategies.
- **Financial Awareness in Clinical Reasoning:** By incorporating cost considerations into PBL cases, students gain an appreciation for the financial implications of their diagnostic decisions. This awareness is essential for developing clinical reasoning skills that are both effective and cost-conscious[21,22].

Incorporation of Social Determinants of Health

PBL curricula that incorporate social determinants of health provide students with a more comprehensive understanding of the factors that influence patient outcomes. This holistic approach enhances clinical reasoning by considering the broader context of patient care.

- **Culturally Competent Care:** By addressing social determinants of health, PBL helps students develop culturally competent clinical reasoning skills. This approach ensures that students are prepared to address the diverse needs of patients from varied backgrounds.
- **Patient-Centered Care:** Incorporating social determinants into PBL cases fosters a patient-centered approach to clinical reasoning. This approach emphasizes the importance of

considering the patient's unique circumstances when developing diagnostic and treatment plans[18,19].

Use of Real-World and Authentic Learning Scenarios

The use of real-world and authentic learning scenarios in PBL ensures that students are prepared for the challenges of clinical practice. These scenarios simulate the complexities of real patient care, providing students with meaningful learning experiences.

- **Authenticity in Learning:** Authentic learning scenarios in PBL help students develop clinical reasoning skills that are applicable to real-world clinical practice. This authenticity enhances the transfer of learning and improves diagnostic accuracy.
- **Complexity of Cases:** PBL cases often involve complex and nuanced clinical scenarios, challenging students to think critically and develop advanced clinical reasoning skills. This complexity prepares students for the unpredictability of real patient care[21,22].

Incorporation of Ethical and Legal Considerations

PBL curricula that incorporate ethical and legal considerations provide students with a well-rounded understanding of clinical reasoning. This component ensures that students are prepared to navigate the ethical and legal complexities of patient care.

- **Ethical Decision-Making:** PBL cases often include ethical dilemmas, requiring students to consider the moral implications of their diagnostic and treatment decisions. This approach fosters the development of ethical clinical reasoning skills, which are essential for competent patient care.
- **Legal Aspects of Care:** By addressing legal considerations in PBL cases, students gain an understanding of the legal framework that governs clinical practice. This knowledge is critical for developing clinical reasoning skills that are both legally sound and ethically appropriate.

Focus on Preventive and Proactive Care

PBL curricula that emphasize preventive and proactive care help students develop clinical reasoning skills that prioritize patient well-being and disease prevention. This approach ensures that students are prepared to address the full spectrum of patient needs, from prevention to treatment.

- **Health Promotion and Disease Prevention:** By incorporating preventive care into PBL cases, students learn to identify risk factors and develop strategies for disease prevention. This proactive approach enhances clinical reasoning by considering the long-term implications of patient care.
- **Patient Education and Empowerment:** PBL cases often include components related to patient education and empowerment, fostering a patient-centered approach to clinical reasoning. This focus ensures that students are prepared to communicate effectively with patients and involve them in decision-making processes[18,19].

Table: Comparison of key components of PBL models

Component	Description	Citation
Small Group Discussions	Collaborative learning environment that fosters teamwork and communication skills.	[10-12]
Self-Directed Learning	Encourages independent study and exploration of learning resources.	[3,6,14]
Integration of Basic and Clinical Sciences	Combines theoretical and practical knowledge for a holistic understanding.	[4,16,19]
Feedback and Reflection	Enhances metacognition and introspection through deliberate reflection.	[13,17,20]
Longitudinal and Spiral Curriculum	Progressive development of skills through repeated exposure to concepts.	[18,19]

Role of Tutors and Facilitators	Expertise and facilitation skills guide effective learning and group dynamics.	[12,13]
Virtual Patients and Simulations	Provides immersive and interactive learning experiences.	[21,22]
Hybrid PBL Models	Combines traditional PBL with other strategies for enhanced learning.	[17,23]
Assessment and Evaluation	Evaluates both diagnostic accuracy and reasoning processes.	[21,22]
Cultural and Community-Oriented Approaches	Focuses on diverse patient needs and social determinants of health.	[18,24]
Metacognition and Reflective Practice	Fosters self-awareness and introspection in clinical reasoning.	[17]
Real Patient Contacts	Provides authentic learning experiences and practical application of skills.	[16]
Concept Mapping and Knowledge Organization	Structures knowledge for better retention and application.	[17]
Pathophysiology and Biomedical Sciences	Links theoretical knowledge with clinical findings.	[16,19]
Cost-Effective Diagnostic Testing	Emphasizes appropriate and efficient use of diagnostic resources.	[21,22]
Social Determinants of Health	Considers the broader context of patient care and outcomes.	[18,19]
Authentic Learning Scenarios	Simulates real-world clinical challenges for meaningful learning.	[21,22]
Ethical and Legal Considerations	Addresses moral and legal implications of clinical decisions.	[18,19]
Preventive and Proactive Care	Prioritizes health promotion and disease prevention.	[18,19]

Conclusion

The PBL model is a robust educational framework that enhances clinical reasoning competence in medical students through its emphasis on small group discussions, self-directed learning, integration of basic and clinical sciences, feedback, reflection, and longitudinal curriculum design. The incorporation of virtual patients, real patient contacts, and cultural considerations further enriches the learning experience. By fostering metacognition, ethical decision-making, and cost-effective diagnostic testing, PBL prepares students for the complexities of clinical practice. The role of tutors, the use of concept mapping, and the focus on preventive care are additional components that contribute to the

model's effectiveness. Overall, the PBL model's ability to simulate real-world scenarios and encourage active, collaborative learning makes it a cornerstone of modern medical education.

References:

1. Feng Zhou, Ai-min Sang. The impact of an integrated PBL curriculum on clinical thinking in undergraduate medical students prior to clinical practice // BMC Med. Educ. 2023. Vol. 23, № 1.
2. Manish Taywade et al. Ensuring Problem-Based Learning for Medical Students and Looking Forward to Developing Competencies. 2022. Vol. 18. P. 1–3.
3. Rayed Alreshidi, Fayez Saud Alreshidi. The Effectiveness of Problem-Based Learning in Improving Critical Thinking and Problem-Solving Skills in Medical Students: A Systematic Review of Fifteen Years' Experience (2005-2019) // World Fam. Med. J. Middle East J. Fam. Med. 2023.
4. Muhammad Zulfiqah Sadikan. Clinical Pharmacology and Problem-Based Learning: The Impact on Medical Students' Prescribing Competency. 2024. Vol. 2, № 2. P. 11–17.
5. Jihyun Si, Hyun-Hee Kong, Sang-Hwa Lee. Developing Clinical Reasoning Skills through Argumentation with the Concept Map Method in Medical Problem-Based Learning. // Interdiscip. J. Probl.-Based Learn. 2019. Vol. 13, № 1. P. 5.
6. Saurabh RamBihariLal Shrivastava, Prateek Saurabh Shrivastava. Proposing a framework to plan and implement problem based learning sessions for undergraduate medical students // Curr. Med. Issues. 2023. Vol. 21, № 1. P. 73–76.
7. Derek C. Macallan et al. A model of clinical problem-based learning for clinical attachments in medicine // Med. Educ. 2009. Vol. 43, № 8. P. 799–807.
8. P Lockwood. Teaching Clinical Reasoning Skills to Undergraduate Medical Students: An action research study. 2017.
9. Samuel N. Heyman et al. [Introduction of a brief Problem-Based-Learning (PBL) experience in traditional medical faculty curriculum]. // Harefuah. 2007. Vol. 146, № 6. P. 435.
10. Hyunjung Ju, Ikseon Choi. The Role of Argumentation in Hypothetico-Deductive Reasoning During Problem-Based Learning in Medical Education: A Conceptual Framework // Interdiscip. J. Probl.-Based Learn. 2017. Vol. 12, № 1. P. 4.
11. Henk G. Schmidt et al. The process of problem-based learning: What works and why. // Med. Educ. 2011. Vol. 45, № 8. P. 792–806.
12. Henk G. Schmidt, Jos H.C. Moust. What makes a tutor effective? A structural-equations modeling approach to learning in problem-based curricula. // Acad. Med. 1995. Vol. 70, № 8. P. 708–714.
13. Qing Wang et al. Developing an integrated framework of problem-based learning and coaching psychology for medical education: a participatory research // BMC Med. Educ. 2016. Vol. 16, № 1. P. 2–2.
14. Munazza Asad, Khadija Iqbal, Mohammad Sabir. Effectiveness of problem based learning as a strategy to foster problem solving and critical reasoning skills among medical students. // J. Ayub Med. Coll. Abbottabad. 2015. Vol. 27, № 3. P. 604–607.
15. José Sánchez Redrobán, Vicente Durán. Problem-Based Learning: A Fundamental Pillar for the Training of Competent Physicians. 2024.
16. Agnes D Diemers et al. Diagnostic reasoning and underlying knowledge of students with preclinical patient contacts in PBL // Med. Educ. 2015. Vol. 49, № 12. P. 1229–1238.
17. Mats Andréén. Implementation of three knowledge-oriented instructional strategies to teach clinical reasoning: Self-explanation, a concept mapping exercise, and deliberate reflection: AMEE Guide No. 150 // Med. Teach. 2022. Vol. 45, № 7. P. 676–684.
18. Mini Singh et al. From principles to practice: embedding clinical reasoning as a longitudinal curriculum theme in a medical school programme. 2021.

19. Jane S Rowat, Manish Suneja. Longitudinal clinical reasoning theme embedded across four years of a medical school curriculum // *Diagnosis*. 2022. Vol. 9, № 4. P. 468–475.
20. Greg Ryan, Terry Dolling, Stewart Barnet. Supporting the problem-based learning process in the clinical years: evaluation of an online Clinical Reasoning Guide. // *Med. Educ.* 2004. Vol. 38, № 6. P. 638–645.
21. Ilja Tachecí, Ales Ryska. Virtual cases in internal medicine education // *Mefanet J.* 2015. Vol. 3, № 1. P. 21–27.
22. Dane M. Chapman et al. Assessing Effectiveness of a Problem-Based Learning Curriculum in Teaching Clinical Reasoning Skills. 2013. Vol. 1, № 1. P. 17–28.
23. Kosuke Ishizuka et al. Hybrid PBL and Pure PBL: Which one is more effective in developing clinical reasoning skills for general medicine clerkship?—A mixed-method study // *PLOS ONE*. 2023. Vol. 18, № 1. P. e0279554–e0279554.
24. Said Said Elshama. How to Apply Problem-Based Learning in Medical Education? A Critical Review. 2019. Vol. 2, № 1. P. 14–18.
25. Tashmamatova D. TIBBIYOT TALABLARINI PEDIATRIYA FANLARINI O'QITISHNI BAHOLASH: SHARH MAQOLA: 1 // *Univers. Xalqaro Ilmiy J.* 2025. Vol. 2, № 1. P. 68–75.

