Problem-Based Learning

Problem-Based Learning (PBL) is an educational approach that focuses on active learning and critical thinking by presenting learners with real-world problems as the starting point for learning. In PBL, students work in small groups to collaboratively solve complex, open-ended problems. This approach aims to promote deeper understanding, problem-solving skills, and the application of knowledge in practical contexts.

Here's how the typical PBL process works:

Problem Presentation: Students are given a real-world problem or scenario that requires them to analyze, research, and come up with solutions. These problems are often designed to be interdisciplinary and complex, requiring integration of knowledge from various subjects.

Group Work: Students form small groups to work together on solving the problem. Each group member brings their unique perspective and knowledge to the discussion.

Problem Analysis: The groups analyze the problem, identifying key issues, missing information, and potential solutions. They break down the problem into manageable components.

Research and Self-Directed Learning: Students identify what they need to learn in order to address the problem effectively. They engage in self-directed research to acquire the necessary knowledge and skills.

Instructor as Facilitator: The role of the instructor in PBL is that of a facilitator rather than a traditional lecturer. The instructor guides discussions, asks probing questions, provides resources, and supports students' learning process.

Group Discussions: Students engage in regular group discussions to share their findings, insights, and proposed solutions. They collaborate to build a collective understanding of the problem and its potential resolutions.

Synthesis and Solution Development: Through discussions and research, students synthesize their findings and develop well-informed solutions to the problem. These solutions may involve creative thinking and the application of theoretical concepts.

Presentation: Groups present their solutions to the class. This step encourages students to communicate their ideas effectively, defend their reasoning, and receive feedback from peers and instructors.

Reflection: After the presentation and problem-solving process, students reflect on their learning experience, the problem-solving strategies they used, and the knowledge they gained.

The benefits of PBL include:

Active Engagement: Students are actively involved in the learning process rather than passively receiving information. Critical Thinking: PBL encourages students to think critically, analyze information, and apply their knowledge in real-world contexts. Problem-Solving Skills: Students develop problem-solving skills that are transferable to various situations. Collaboration: PBL fosters teamwork and collaboration as students work together to solve problems. Application of Knowledge: Students apply theoretical concepts to practical situations, enhancing their understanding and retention. PBL is commonly used in medical and health sciences education, as well as other fields where practical problem-solving skills are essential. It promotes a learner-centered approach and prepares students for complex, dynamic challenges they may encounter in their careers.

Problem-Based Learning in neurosurgery

- A Generative Artificial Intelligence Copilot for Biomedical Nanoengineering
- Student engagement in a flipped undergraduate medical classroom to measure optimal video-based lecture length
- Problem-Based Learning-Standardized Preoperative Conversation Improves Neurosurgery Residents' Understanding of Cerebellopontine Angle Tumors
- Comparison of face-to-face teaching and online teaching in neurosurgery education for medical students
- CGNet: Few-shot learning for Intracranial Hemorrhage Segmentation
- TSPE: Reconstruction of multi-morphological tumors of NIR-II fluorescence molecular tomography based on positional encoding
- Two-Step Transfer Learning Improves Deep Learning-Based Drug Response Prediction in Small Datasets: A Case Study of Glioblastoma
- Evolving concepts in intracranial pressure monitoring - from traditional monitoring to precision medicine

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A meta-analysis was conducted to systematically evaluate the impact of problem-based learning (PBL) and lecture-based learning (LBL) teaching models on students' learning in surgical education.

Methods: We systematically searched the publications related to the application of PBL and LBL in surgical courses in PubMed, Embase, Web of Science and Cochrane Library databases, the last retrieval time is September 20, 2022. After screening the literature according to the inclusion and exclusion criteria, extracting data and evaluating the methodological treatment of the included studies, Stata 17.0 software was used to perform meta-analysis.

Results: Nine studies were included totally. The results showed that compared with LBL, PBL was superior in clinical competence (SMD = 0.81, 95% CI: 0.12 ~ 1.49, P = 0.020) and student satisfaction (SMD = 2.13, 95% CI: 1.11 ~ 3.15, P < 0.0001) with significant differences. But the comprehensive scores (SMD = 0.26, 95% CI: -0.37 ~ 0.89, P = 0.421) and theoretical knowledge (SMD=-0.19, 95% CI: -0.71 ~ 0.33, P = 0.482) to PBL and LBL had no significant difference.

Conclusion: This study showed that the PBL teaching model is more effective than the LBL teaching model in surgical education on the aspects of enhancing clinical competence and student satisfaction. However, further well-designed studies are needed to confirm our findings [1)]

Serious Games (SG) are an educational strategy used in the health professions with positive results in teaching diagnosis and facilitating the application of concepts and knowledge transfer. A type of SG is the branching scenario, which has the potential for a linear story or multiple options to achieve learning goals. There must be evidence for this type of SG's instructional design (InD) and usability.

Objective: Propose an InD for the branching scenario and rate its usability.

Materials and methods: We conducted a two-phase study. In the first phase, we drafted an InD based on the literature review, and then, we applied an expert validation process through a modified Delphi technique. With the consent of InD, we built five branching scenarios. In the second phase, we apply an instrument to measure the SG usability of the branching scenarios in a cross-sectional study with 216 undergraduate medical students.

Results: A proposal for an InD for branching scenarios was elaborated. This InD has five dimensions with steps and definitions that help the designer fulfill the requirements for the SG. With the InD, we developed five branching scenarios for undergraduate medical students. Finally, the rates for the usability of the branchings had high scores. The branching SG with multiple options offers different outcomes for the same clinical problem in a single activity.

Discussion: The proposal of a specific InD for branching scenarios considered SG theory and was tested, at least in user usability. The steps proposed include the specificity of the requirements of an SG, such as levels, checkpoints, avatars, and gameplay characteristics, among others, in contrast to the other InD that do not explicitly consider them. One of the limitations of this study is that we applied it only using the H5P software to develop branching scenarios with no other evidence of the performance of the InD in different contexts or platforms.

Conclusions: We propose using an InD to construct branching scenarios. This kind of SG has specific characteristics for its correct operation. Using structured steps in developing SG improves the probability of developing decision-making skills. Using an instrument to assess the usability of at least one dimension of the SG is also recommended to identify opportunity areas [2)]

Example

Scenario: A group of medical students with an interest in neurosurgery is presented with the following problem:

“A 45-year-old male patient is admitted to the emergency department with sudden-onset severe headaches, blurred vision, and difficulty maintaining balance. Upon examination, you notice papilledema (swelling of the optic disc) and signs of increased intracranial pressure. The patient's medical history includes hypertension and obesity. Design a comprehensive management plan for this patient, including a differential diagnosis, relevant diagnostic tests, treatment options, and potential complications.”

PBL Process:

Problem Presentation: The students are introduced to the patient's case, including presenting symptoms, medical history, and clinical findings.

Group Formation: Students form small groups to collaboratively work on solving the case.

Problem Analysis: The groups analyze the problem, identify key symptoms, and consider potential underlying causes. They brainstorm a list of possible conditions that could be responsible for the patient's presentation.

Research and Learning: Students recognize the need for more information and conduct independent research to understand the different conditions that could lead to the symptoms described.

Diagnostic Considerations: Groups create a list of diagnostic tests that could help confirm or rule out their potential diagnoses. They discuss the relevance of each test based on the patient's presentation.

Treatment Strategies: Students identify potential treatment options for each of the diagnoses they've considered. They evaluate the pros and cons of each approach, taking into account the patient's medical history and condition.

Risk Assessment: Groups consider potential complications and risks associated with the proposed treatment options. They discuss how to monitor and manage these risks.

Discussion and Synthesis: Students come together to discuss their findings, diagnoses, and treatment plans. They compare their conclusions and learn from each other's perspectives.

Presentation: Each group presents their findings and recommendations to the class. This encourages students to articulate their reasoning, defend their choices, and receive feedback.

Reflection: After the presentations, students reflect on the process, what they've learned, and how they approached the problem. They consider the challenges they faced and how they might apply this experience to future cases.

Through this PBL exercise, students are actively engaged in critical thinking, research, and problem-solving. They learn not only about specific neurosurgical conditions but also about collaborative teamwork, effective communication, and the importance of considering a patient's overall health when developing a treatment plan. This approach prepares them to apply their knowledge and skills to real-world clinical scenarios they might encounter in their future careers as neurosurgeons.

[1]
Zheng QM, Li YY, Yin Q, Zhang N, Wang YP, Li GX, Sun ZG. The effectiveness of problem-based learning compared with lecture-based learning in surgical education: a systematic review and meta-analysis. BMC Med Educ. 2023 Aug 1;23(1):546. doi: 10.1186/s12909-023-04531-7. PMID: 37528406.

[2]
Argueta-Muñoz FD, Olvera-Cortés HE, Durán-Cárdenas C, Hernández-Gutiérrez L, Gutierrez-Barreto SE. Instructional Design and Its Usability for Branching Model as an Educational Strategy. Cureus. 2023 May 18;15(5):e39182. doi: 10.7759/cureus.39182. PMID: 37332404; PMCID: PMC10276579.