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Design and implementation of the BOPPPS-PBL model in the teaching of TCM surgery

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Highlights

- The integration of the BOPPPS comprehensive teaching approach with problem-based learning in Traditional Chinese Medicine surgery education is proposed.
- Using eczema as a case study, the focus is on implementing a student-centered, problem-oriented teaching model.
- Enhancing the faculty team and implementing a robust feedback mechanism can improve students' learning outcomes.

Abstract

Surgery of Traditional Chinese Medicine (TCM) is a core course within the TCM curriculum and an indispensable clinical discipline for all medical students transitioning to professional practice. With the deepening of curriculum reforms, the integrated teaching model has proven effective in helping students master basic theories and clinical skills. Among various teaching models, the Bridge-in, Learning Objectives, Pre-Assessment, Participatory Learning, Post-Assessment, and Summary (BOPPPS) model combined with Problem-Based Learning has gained widespread recognition and application. However, its application in TCM surgery education remains limited. This paper integrates the BOPPPS and problem-based learning (PBL) teaching models into the TCM surgery classroom, using eczema as a case study. This teaching design encompasses six elements: bridge-in, learning objectives, pre-assessment, participatory learning based on Problem-Based Learning, post-assessment, and summary. Potential challenges during the teaching process are also examined to enhance students' clinical critical thinking abilities, improve the quality of classroom teaching, and further cultivate high-quality TCM professionals through the application of the BOPPPS-PBL model.

Keywords: Surgery of traditional Chinese medicine, BOPPPS teaching model, PBL teaching model, teaching design, medical education

Introduction

Surgery of Traditional Chinese Medicine (TCM) focuses on various surgical diseases, including sores and ulcers, dermatological conditions, breast ailments, and proctology, all interpreted through TCM theory. It is a crucial subject for every TCM student transitioning to clinical practice. Surgical diseases typically present with more readily identifiable clinical features compared to internal diseases, yet they can still lead to diagnostic confusion. For instance, in the realm of dermatology, many dermatological conditions share similar rash manifestations, requiring students to quickly and accurately differentiate them, a task that is quite challenging. Thus, the need to stimulate students' interest and improve their ability to differentiate and treat TCM syndromes within limited classroom time necessitates the adoption of a new teaching model.

In conventional teaching methods, the teacher assumes the role of the primary source of

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knowledge, with the students acting as passive recipients. While this method may facilitate effective classroom management, it has several drawbacks. The lack of interaction between teachers and students often leads to ineffective communication regarding students' knowledge gaps or weaknesses. Furthermore, the traditional teaching model neglects the cultivation of students' critical thinking. Most conventional teaching models rely heavily on high-intensity cramming of information, easily overwhelming students and weakening their ability to analyze problems independently. As a clinical discipline, TCM surgery teaching should focus on guiding students to quickly identify disease characteristics, enhance their critical thinking, and make accurate treatment decisions.

In response to the aforementioned problems, educators have explored various teaching models and achieved positive results, including Bridge-in, Learning Objectives, Pre-Assessment, Participatory Learning, Post-Assessment, and Summary (BOPPPS), Small Private Online Course, Massive Open Online Course, Team-based Learning, and Problem-based Learning (PBL). Previous studies have shown that hybrid teaching approaches can effectively improve students' engagement in the classroom and enhance their self-directed learning capabilities, and proficiency in TCM practice [1-3]. Among these models, the integrated BOPPPS and PBL model has become increasingly popular in China in recent years. The effectiveness of the BOPPPS teaching model has been widely documented across multiple TCM disciplines, such as internal medicine, surgery, and osteology and traumatology [4-6]. A recent study applying the BOPPPS model to TCM surgery education revealed significant improvements in students' learning interest, academic self-efficacy, analytical skills, and other related aspects [7].

On the other hand, PBL emphasizes a problem-centered and student-focused learning process. By engaging students in problem-solving activities, PBL effectively enhances the quality of classroom instruction and fosters deeper learning in students. Studies indicate that PBL not only stimulates student's interest but also promotes learning autonomy, clinical reasoning, and knowledge application [8]. Based on these findings, we propose the integration of BOPPPS and PBL teaching models into the TCM surgery curriculum. This model aims to shift students from passive recipients of information to active participants, to encourage them to engage in problem-solving, and to immerse themselves fully in the learning process.

BOPPPS and PBL teaching models

The BOPPPS model was developed by Douglas Kerr et al. from the University of British Columbia [9]. This model comprises six key components: Bridge-in, Learning Objectives, Pre-Assessment, Participatory Learning, Post-Assessment, and Summary [10]. Characterized by bidirectional knowledge transfer, the BOPPPS model emphasizes a student-centered, goal-oriented approach with active teacher-student interaction. By applying this model, teachers can assess students' baseline learning status, establish instructional objectives, address students' knowledge gaps during class, and finally evaluate teaching effectiveness through assessments or student feedback. It has been reported that the BOPPPS model is effective across various medical disciplines. Compared with traditional teaching methods, it enhances medical students' problem-solving abilities, improves classroom teaching quality, and holds significant value for educational advancement [11, 12].

PBL was first introduced at McMaster University Medical School in the mid-1960s, emphasizing problem-solving as the primary method of learning [13]. The six essential steps in the PBL model are as follows: (1) Learning in PBL is always student-centered; (2) Teachers organize students into learning groups; (3) Teachers act as facilitators or guides; (4) Topic-related problems serve as the central focus of the learning process, fostering enthusiasm for pursuing knowledge; (5) Students develop problem-solving skills through clinical problems; (6) Learning is self-directed, with students acquiring new information independently [14]. In contrast to conventional learning methods, PBL shifts the focus of instruction from the teacher to the student, transitions from individual to collaborative learning, and encourages the development of independent problem-solving skills. In clinical disciplines, PBL can transform the teaching process by starting and ending with problems. These interconnected and progressive problems guide the learning journey, creating an exploratory and problem-solving environment. In this model, teachers are not merely transmitters of knowledge but designers of learning challenges and facilitators guiding students through the process.

The BOPPPS-PBL teaching model in the teaching design of TCM surgery-a case study of eczema

In alignment with the six elements of the BOPPPS model and the problem-oriented PBL

model, this article proposes integrating PBL into the BOPPPS teaching framework. Using eczema as a case study, the teaching design encompasses bridge-in (case introduction), learning objectives, pre-assessment, PBL-based participatory learning, and other relevant components. The specific classroom teaching design is as follows:

(1) Bridge-in: A 21-year-old male presented to the clinic with a sudden onset of generalized erythema and vesicles, accompanied by severe itching, which had persisted for three days without prior medical intervention. On examination, the patient presented with generalized erythema, papules, vesicles, local erosion, and exudation, along with intense pruritus, restlessness, thirst, dry stools, scanty dark-colored urine, a red tongue with a thin yellow coating, and a slippery pulse.

Questions: What is your diagnosis for this patient? What are the main characteristics of this condition? If you were the attending physician, what would you do? This approach aims to stimulate students' curiosity in disease diagnosis and treatment, fostering a sense of responsibility and commitment to the medical field.

(2) Learning Objectives: 1) Competency Objectives: To enhance cultural self-confidence, promote students' autonomy in learning, cultivate a desire for knowledge exploration, and instill a sense of responsibility and professionalism in future medical professionals. 2) Knowledge Objectives: To understand the definition and classification of eczema; to master its etiology, pathogenesis, preventive measures, and nursing practices; and to proficiently apply, syndrome differentiation, and treatment methods in clinical practice. 3) Skill Objectives: To develop the ability to independently diagnose and treat eczema based on syndrome differentiation, and to acquire basic clinical skills in the diagnosis and teatments of such cases.

(3) Pre-assessment: It is essential to assess students' understanding of foundational concepts early in the course. This can be achieved by posing questions related to key aspects such as distinguishing between yin and yang syndromes in previously covered surgical chapters. Additionally, students should be prompted to describe the characteristics of itching caused by dampness and blood deficiency in local syndrome differentiation, and to elucidate manifestations like damp swelling. These questions will lay the foundation for subsequent discussions on the syndrome differentiation and treatment of eczema. Moreover, it is crucial to gauge students' preparedness before starting the lesson. For instance, the teacher may ask whether students have encountered individuals suffering from eczema in their surroundings. Subsequently, addressing any questions or ambiguities raised by students can help strengthen their understanding and retention of the subject matter.

(4) PBL-based participatory learning: Participatory learning is a core component of the BOPPPS teaching model, emphasizing the active role of students in the classroom. In this phase, students are no longer passive recipients of knowledge but actively engage in knowledge acquisition. Diagnosis, differential diagnosis, etiology and pathogenesis, and treatment based on syndrome differentiation are the core components of critical thinking in TCM. These elements are closely interlinked, forming a complete logical cycle of "identifying the disease—differentiating syndromes—exploring the cause—syndrome differentiation and treatment." Clinical symptoms and signs are observed using the TCM diagnostic methods of inspection, auscultation and olfaction, inquiry, and palpation (four diagnostic methods). Differential diagnosis is then applied to rule out similar conditions, leading to a preliminary diagnosis. Subsequently, the etiology and pathogenesis are analyzed to investigate the underlying causes and disease mechanisms. Finally, treatment strategies are formulated based on the identified etiology, pathogenesis, and specific syndrome differentiation to ensure a coherent and effective prescription. In participatory learning, aligned with the PBL model, the teacher designs questions based on curriculum knowledge points and guides students to analyze and discuss the content. The teacher facilitates learning by asking questions and providing continuous guidance, correcting deviations in student explanations and thereby systematically improving students' logical thinking ability through repeated emphasis on key concepts.

For the eczema case, the teacher can divide the students into three groups, with each group receiving three pictures depicting psoriasis, contact dermatitis, and eczema (at different stages). By engaging in independent study, group discussions, and answering questions, students can deepen their understanding of eczema through active inquiry. This process helps them master the diagnostic points, etiology, pathogenesis, differential diagnosis, and syndrome differentiation of eczema.

Diagnostic criteria for eczema: Students are

given three images and are asked to identify the one depicting eczema. They are prompted to consider the most distinguishing characteristic of the eczema lesions. The teacher then clarifies that, despite the distinct skin lesions, all the images represent eczema. Key clinical features of eczema include symmetrical distribution, polymorphic lesions, and intense pruritus.

Differential diagnosis of eczema: The groups are asked to identify two other possible diseases from the images and compare them with eczema, focusing on the differences. The teacher guides the discussion and elaborates on the differences between eczema, contact dermatitis, and psoriasis, emphasizing the distinction between acute eczema and contact dermatitis. Charts are used to compare factors such as etiology, predilection sites of the lesions, rash presentation, demarcation of skin lesions, and patient history (e.g., exposure to irritants).

Etiology and pathogenesis in TCM: The discussion covers the stages of eczema and the underlying mechanisms of exudation, scaling, and skin roughness during the different phases of the disease. In TCM, eczema progresses from an acute phase (associated with damp-heat) to a subacute phase (marked by spleen deficiency and dampness), and finally to a chronic phase, which is linked to yin-blood depletion, blood deficiency, and dry wind.

Syndrome differentiation and treatment: The teacher engages students in identifying characteristic manifestations and accompanying symptoms of eczema at various stages, and in analyzing tongue and pulse characteristics from a TCM perspective. Students are prompted to classify the patient's condition and consider potential treatments, based on the questions raised by the teacher. A closed-loop analysis of clinical cases is performed, allowing students to deeply explore in depth the variations in eczema syndromes, such as:

• Damp-heat accumulation syndrome, characterized by sudden onset, brief duration, and polymorphic skin lesions with damp-heat manifestations and intense inflammation;

• Spleen deficiency with damp-heat accumulation syndrome, a later stage of the disease with a slower onset, chronic lesions (scales, erythema, papules, exudation), accompanied by symptoms such as anorexia, loose stools, and fatigue;

• Blood deficiency with wind-dryness syndrome, recurrent eczema with dark pigmentation, rough, thickened skin lesions, and a prolonged course.

(5) Post-assessment: In addition to traditional methods such as classroom discussions, study questions, and in-class tests, teachers can employ after-class questionnaires to gather timely feedback on teaching effectiveness. For example, in a dermatology class, teachers can assess students' understanding of eczema by quizzing them on syndrome types, treatment principles, and common prescriptions. Group members collaborate to provide comprehensive answers, which the teacher assesses and grades. Moreover, assigning post-class homework tasks, such as identifying images of eczema, enables teachers to address individual queries, reinforce key concepts, and clarify challenging topics.

(6) Summary: The teacher reviews the cases presented at the beginning of the class and elaborates on the overall reasoning process. This review aims to thoroughly clarify key points and difficult areas aligned with the teaching objectives, helping students build their own framework for TCM syndrome differentiation. Additionally, teachers may prompt students to extend their learning beyond the lecture by guiding them to discuss recent advancements in disease research, prescription guidelines, and the compatibility of commonly prescribed clinical herbs.

Discussion

The implementation of the BOPPPS teaching model in China since 2011 has shown positive outcomes in various TCM courses [15, 16]. Additionally, the utilization of the PBL teaching model in TCM surgery has been shown to enhance students' self-directed learning capabilities [17]. The integration of these two methods creates a student-centered, problem-oriented approach that shifts the role of teachers from an authoritative figure to a facilitator, while students transition from passive recipients to active participants. This shift encourages increased teacher-student interaction, fosters students' independent problem-solving skills, and improves the overall quality of classroom instruction. The combined use of BOPPPS and PBL models has proven effective in boosting student engagement and enhancing teaching effectiveness in fields such as Western surgery and pediatric surgery [18-20]. This integrated model invigorates students' learning motivation, strengthens their independent learning capacity, and improves their proficiency in TCM

reasoning. Nonetheless, successful implementation of this model requires continuous adjustment and refinement by both teachers and students to master TCM theoretical knowledge, strengthen students' cultural confidence, and better cultivate skilled TCM professionals.

However, there are several practical challenges in applying this model. For example, in large classes or resource-limited educational settings, teachers need to simplify the participatory learning process based on the PBL model, focusing on specific problems and reducing reliance on external resources. This simplified approach should return to the essence of interpersonal interaction. In the participatory learning stage, teachers can divide students into groups based on seating arrangements, assign, tiered tasks, designate keyword recorders and spokespersons for each group, and use the discussion outcomes of one group as materials for the next group. By setting clear time limits and guiding the discussions around specific issues, the success of the activity is reflected in whether students' final clinical logical thinking is established. Without such logical thinking, it becomes difficult to complete a coherent learning loop. This method allows students themselves to become valuable resources, transforming the challenge of group formation and cooperation in large classes into an advantage. It encourages collective problem-solving, fosters students' interest in learning, and strengthens their sense of academic ownership and achievement. Therefore, to improve the efficiency of this model, it is essential to strengthen teacher training and establish an efficient, positive feedback mechanism for students.

Establishing a positive feedback mechanism is crucial for students in the context of the BOPPPS-PBL teaching model. The effectiveness of this model hinges not only on students having a fundamental understanding of TCM at the outset but also on their ability to actively identify and address gaps in their knowledge. Particularly in PBL-based participatory learning, students are expected to engage in critical thinking, overcome hesitation, participate in group discussions, and communicate actively. Consequently, teachers should implement a positive feedback mechanism throughout key stages, such as the pre-assessment stage, interactive questioning, and the post-assessment stage. This approach encourages students to fully immerse themselves in the learning process, actively participate, respond to queries, and express their viewpoints, thereby establishing a solid foundation for the successful implementation of this teaching model.

Continuous improvement and optimization of teaching methods are essential. While the teaching framework may remain consistent, the methods employed can be diversified to achieve better outcomes. Finding the optimal balance between teachers and students is crucial for maximizing classroom effectiveness. Teachers can enhance their teaching strategies through practical measures such as creating feedback questionnaires and facilitating mutual evaluations between teachers and students. Additionally, appropriately leveraging AI technology in the classroom can help break down knowledge barriers, visually and effectively illustrate disease characteristics, and extend the learning experience beyond the classroom. These approaches deepen students' understanding and mastery of theoretical knowledge in TCM surgery, promote classroom engagement, foster self-directed learning, and enhance students' critical thinking and innovation abilities.

Conclusion

In conclusion, by integrating the BOPPPS and PBL models, we can adopt a problem-solving approach, facilitate discussions based on clinical cases, and conduct in-depth analyses of disease characteristics. This integration improves students' independent learning capabilities through a continuous problem-solving process, bridges the gap between theoretical knowledge and clinical practice, strengthens students' critical thinking skills, and ultimately increases the effectiveness of classroom instruction.

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