PBL Teaching Research and Practice for the "Pharmaceutics Experiment" Course at Local Applied Universities Based on the OBE Concept

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Abstract: The "Pharmaceutics Experiment" course is a key core subject for pharmaceutical students, characterized by its strong practical component. Developing an effective experimental teaching system is crucial for cultivating high-quality, innovative talent. Establishing a teaching model focused on innovation is a vital approach to talent development. This study addresses issues in traditional teaching methods for the "Pharmaceutics Experiment" course by reforming educational concepts and integrating the OBE philosophy with the PBL approach. By centering on student engagement, guiding them through problem-based learning to foster innovation, and setting student-generated outcomes as teaching goals, this approach aims to innovate talent development models and enhance teaching quality.

***Keywords*:** OBE philosophy; local applied universities; pharmaceutics experiment; teaching reform; PBL teaching method

1. Introduction

Outcomes-Based Education (OBE) and Problem-Based Learning (PBL) are prominent educational philosophies and methods internationally. OBE focuses on a student-centered approach with a clear emphasis on learning outcomes, constructing curricula in reverse based on students' professional competencies to define talent development goals more precisely and create a more effective educational direction and momentum[1]. PBL, on the other hand, is a problem-oriented teaching method where students work in groups to independently gather information, analyze, and ultimately solve problems[2]. Both OBE and PBL are highly compatible in their educational goals, emphasizing student-centered learning, problem orientation, and active student exploration. PBL effectively embodies the principles of OBE, serving as a concrete implementation strategy for this educational philosophy.

2. Characteristics of the "Pharmaceutics Experiment" Course and the Role of Local Applied Universities

The "Pharmaceutics Experiment" course is a key core subject for students in pharmaceutical engineering, distinguished by its strong practical focus. We propose adopting a talent cultivation model based on the OBE philosophy and the PBL teaching method. By integrating problem-based learning, we aim to guide students towards innovation, making student-generated outcomes the primary goal. This approach transforms passive, teacher-centered learning into active, student-centered exploration, thereby enhancing both the innovation in talent development and the quality of teaching.

As pillars of national strategic technological power, higher education institutions play a crucial role not only in delivering scientific achievements to the nation and society but also in producing talent, particularly internationalized and innovative application-oriented professionals aligned with national strategies. Local universities should align the course's characteristics with the specific needs of the regional pharmaceutical industry, focusing on cultivating talent that serves local industry needs.

Currently, "Pharmaceutics Experiment" teaching often revolves around a textbook-centered approach, making the content somewhat dry and difficult for students to connect theoretical principles to practical pharmaceutical production. Consequently, students' engineering application skills are insufficient. Therefore, there is a pressing need to elevate the "Pharmaceutics Experiment" teaching process in applied local undergraduate institutions to better align with the demands of modern pharmaceutical enterprises and improve students' engineering application capabilities.

3. Designing "Pharmaceutics Experiment" Course Content Based on the OBE Philosophy

Under the guidance of the OBE philosophy, the design of the "Pharmaceutics Experiment" course content shifts from a discipline-based approach to one that addresses student employment and development needs. The fundamental requirements for the "Pharmaceutics Experiment" course are to ensure students acquire foundational knowledge, basic theories, and essential skills in pharmaceutics. Students should also develop capabilities in drug design and development, demonstrate innovation awareness, and possess safety, environmental, and sustainability consciousness. Additionally, students should be proficient in using computer and information technologies to acquire, process, and apply information in pharmaceutics and related fields, and develop both written and oral communication skills, as well as coordination and teamwork abilities. They should also be adaptable to future scientific and technological advancements and socio-economic developments.

To achieve these objectives, the course is designed to emphasize student self-directed learning, with a focus on creating conducive conditions and environments that accommodate diverse learning styles and needs. This approach aims to prepare students to become innovative pharmaceutical engineers required by national and industrial sectors. Guided by OBE principles, the content of the "Pharmaceutics Experiment" course should be cutting-edge and systematic, incorporating elements of safety, environmental protection, and green design. Students will conduct experiments in groups, collaboratively process data, and utilize experimental software as appropriate. Thus, the experimental design and practice will be oriented towards research questions, reflecting the scientific, advanced, and open nature of the teaching content.

4. Constructing the PBL Teaching Model for the "Pharmaceutics Experiment" Course Based on the OBE Philosophy

The PBL teaching model centers on students, guiding them to solve practical problems to achieve learning objectives[3]. This approach focuses on enhancing students' problem analysis and resolution skills, teamwork, writing and communication abilities, and overall engagement. It shifts from traditional passive learning to an active problem-solving method, stimulating students' initiative and participation, while teachers transition from knowledge providers to facilitators of problem-solving.

The OBE philosophy is a results-oriented teaching approach that emphasizes proactive learning and exploration. It ensures that all students achieve success, focuses on personalized assessment and evaluation, and highlights process-based evaluation and assessment. By adhering to the principles of being student-centered, outcome-oriented, and continuously improving, OBE introduces a new path for classroom teaching reform. This mechanism is crucial for developing graduates who are knowledgeable, creative, highly skilled, adaptable, innovative, and capable of critical thinking. Both PBL and OBE share a student-centered, problem-oriented, and exploratory focus. OBE constructs the curriculum based on students' professional competency needs, which is then implemented through the PBL model. Thus, the PBL teaching model effectively embodies the OBE philosophy and serves as a concrete implementation strategy for it. The construction approach for the Pharmaceutics Experiment course based on OBE education philosophy and PBL teaching method is illustrated in Figure 1.

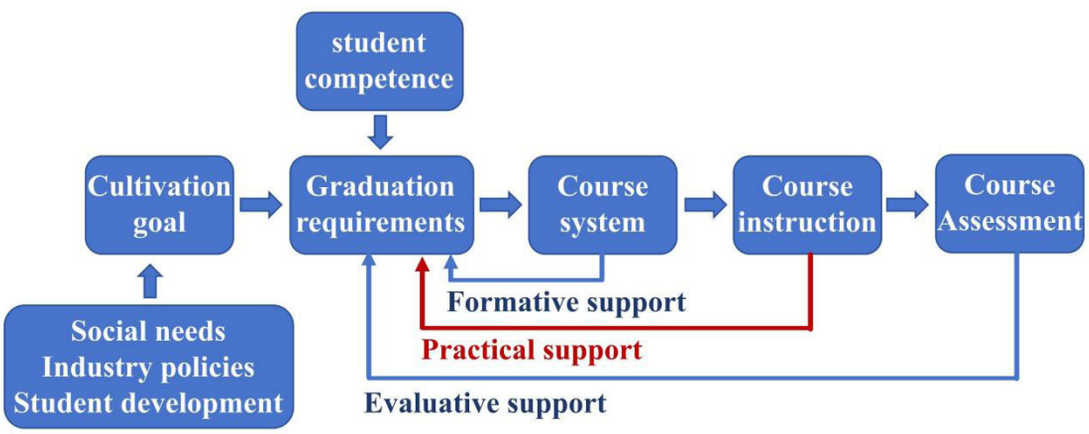

Figure 1. Construction Approach for the "Pharmaceutics Experiment" Course Based on OBE Education Philosophy.

5. Exploring the Application of the PBL Teaching Model Based on the OBE Philosophy in the "Pharmaceutics Experiment" Course

Educational reform should be grounded in achieving reform goals, with backward design being central to outcome-based education. This approach involves designing the curriculum based on the desired final outcomes. The starting point of teaching shifts from what the teacher can teach to what is necessary for achieving the best results. The learning process follows a sequence of "internal and external needs → educational objectives → graduation requirements → curriculum system," and devises a talent development plan aimed at optimizing knowledge to foster healthier individuals.

5.1 Transition from a Closed Classroom to an Open Classroom

Traditional classroom teaching is time-bound and content-fixed, with students primarily repeating predefined experimental procedures, which limits their thinking and practical application abilities. The OBE-based PBL teaching model, however, modularizes course content and integrates OBE concepts with traditional pharmaceutics experiments. By creating modules for pharmaceutics techniques such as grinding, sieving, mixing, granulation, and tablet pressing, and incorporating PBL methods, this model guides students through problem-based objectives, leading them to design their research proposals and analyze experiments in detail. This approach significantly stimulates students' initiative and engagement.

5.2 Transition from Knowledge-Based to Competency-Based Classrooms

Traditional classrooms are teacher-centered, with knowledge divided into isolated units that weaken the connections between them, preventing students from gaining a holistic understanding of the subject. The OBE-based PBL model introduces pharmaceutical science and safety issues, aiming to produce effective, stable, and safe pharmaceutical products. This model enhances students' problem analysis and resolution skills, with teachers guiding and assisting students through problem-based and feedback-driven methods. This shift from "learning without thinking" to "integrated learning and thinking" facilitates the transition from a knowledge-based to a competency-based classroom.

5.3 Transition from Competitive to Collaborative Classrooms

Traditional classroom assessments focus on grading, creating a competitive environment among students. In contrast, the OBE-based PBL teaching model emphasizes success for everyone, with group members taking on different roles based on their abilities, fostering cooperative learning and teamwork. This approach ensures that all students achieve their set goals and learning outcomes.

5.4 Transition from Comparative to Achievement-Based Evaluation

Traditional classrooms often prioritize the teacher's teaching performance, overlooking the students' learning status, with assessments typically focusing heavily on lab reports. The OBE-based PBL teaching model, however, emphasizes personalized assessment and evaluation. It focuses not only on experimental results but also on students' learning attitudes throughout the process and their contributions to their group roles. This approach stresses self-comparison rather than comparing students against each other, providing a comprehensive and objective assessment of students and fair evaluation. Therefore, we have adjusted the course assessment methods to emphasize process evaluations, including quizzes, classroom discussions, experimental design, and teamwork. The final grades more accurately reflect students' overall abilities and personal progress. The evaluation approach for the Pharmaceutics Experiment course based on OBE education philosophy and PBL teaching method is illustrated in Figure 2.

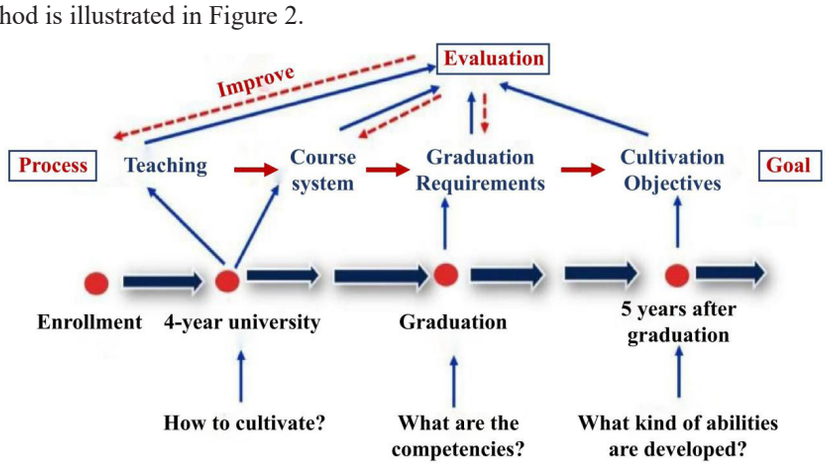

Figure 2. Evaluation Approach for the Pharmaceutics Experiment Course Based on OBE Education Philosophy and PBL Teaching Method

6. Reflections and Insights on Integrating OBE with PBL Teaching Reform

6.1 Role Transformation is Fundamental

In the PBL teaching process, teachers must first recognize their significant role change[4]. This shift involves moving from a primary focus on "teaching" to "guiding" in both thought and action, allowing more time for literature review and designing experiments from the perspective of enhancing student interest and aligning with pharmaceutics practice. Teachers need to stay updated on the latest developments in their field and possess robust pharmaceutics practice knowledge. After class, teachers should summarize experiences and continuously refine teaching methods to develop a PBL approach better suited to their discipline, thereby enhancing their overall teaching capabilities.

6.2 Scientific Evaluation is Motivational

Prior to implementing the PBL model, student evaluation was limited to experiment attitudes, report writing, and attendance[5]. This approach led to significant issues with plagiarism and did not effectively develop students' comprehensive abilities. With the PBL model, a diversified evaluation system has been introduced. Students must actively engage in every aspect of PBL to achieve desirable results. Teacher assessments now provide a more comprehensive and objective reflection of students' abilities, including critical and creative thinking, knowledge integration and application, problem-solving skills, teamwork, and communication abilities.

7. Discussion and Future Directions

This study, based on the PBL teaching model and OBE philosophy, explores the application of an OBE-based PBL model in the "Pharmaceutics Experiment" course. It establishes a problem-centered, student-focused approach that develops students' problem-solving, teamwork, and innovative capabilities. This method not only effectively improves teaching outcomes but also innovates the talent development process. The findings offer valuable insights for the reform of other experimental courses, suggesting potential benefits for broader educational practices.

However, there are certain drawbacks to this teaching method. Students often need to invest significant time in literature review to define their research goals and plans, which can lead to difficulties in managing other academic responsibilities, especially under heavy coursework pressure. This may cause resistance and frustration among students. While teachers can provide periodic guidance, excessive intervention may reduce student autonomy and increase dependency.

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