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Research on the application of OBE-PBL teaching mode in the course of Logistics Information Management in higher vocational colleges

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Abstract

China attaches great importance to the reform and development of vocational education and has introduced a series of policies, announcements, and regulations to support and guide its progress. At the same time, these measures raise new requirements for the reform of vocational education teaching. Deepening the reform of vocational education teaching, optimizing the teaching structure, and innovating teaching methods and models to improve teaching quality and cultivate comprehensive talents have become urgent priorities. This study takes the modern logistics program of a vocational college in Tongling as a case study and investigates and analyzes the current state of teaching for the course "Logistics Information Management." Based on the OBE (Outcomes-Based Education) philosophy and the PBL (Project-Based Learning) teaching model, this study integrates problem-driven learning and project-based teaching throughout the entire course of "Logistics Information Management." It aims to build a teaching strategy that is "student-centered and outcome-oriented." The course design adopts a three-phase integrated model—pre-class, in-class, and post-class—to ensure a comprehensive approach to course implementation. This strategy emphasizes the entire process of project-based learning and aims to enhance students' ability to solve real-world problems, thereby improving the quality of course teaching. The results show that the course design based on the OBE philosophy and the PBL model effectively increases students' initiative and engagement in learning, significantly enhances their overall competencies, and substantially improves teaching quality.

Keywords

OBE, PBL, Logistics Information Management, higher vocational colleges.

1. Introduction

In the current teaching practices of "Logistics Information Management" in vocational colleges, the majority of instructors still primarily employ traditional case-based teaching methods. These methods typically require students to follow a set sequence of steps to complete projects, which often leads to neglecting the development of students' creative abilities and problem-solving skills. As a result, students' overall learning experience is suboptimal.

The Project-Based Learning (PBL) approach, however, encourages instructors to design real-life scenarios that match students' cognitive levels. Through problem-driven instruction, students are guided to independently acquire knowledge and collaborate to complete tasks, applying interdisciplinary knowledge to solve practical problems. This approach not only stimulates students' interest in learning but also cultivates their creativity and problem-solving skills. PBL has been widely implemented in engineering education with considerable success.

PBL emphasizes the use of real-world projects or tasks to promote learning, embodying the educational philosophy of "learning by doing." By engaging in group-based problem solving and project completion, students develop a wide range of skills, including teamwork, communication, and conflict resolution. Furthermore, PBL enhances students' critical thinking, collaborative skills, self-directed learning capabilities, and problem-solving abilities, which significantly contribute to achieving learning outcomes. Consequently, PBL serves as a potent remedy for the shortcomings of traditional teaching methods. Presently, PBL is being increasingly applied across various courses, demonstrating significant educational benefits.

Outcomes-Based Education (OBE) is an advanced educational philosophy that emphasizes a learning outcome-oriented approach. In an OBE framework, both teachers and students have a clear understanding of the desired learning outcomes from the onset of the educational process. Teaching activities are then designed in reverse to align with these pre-established outcomes, effectively preventing aimless learning and ensuring a more purposeful educational experience. OBE places students at the center of the learning process, evaluating their achievements through real-world performance and project work, rather than relying solely on traditional examination-based assessments. This holistic assessment approach enables a more comprehensive evaluation of students' abilities.

In light of these perspectives, this study aims to develop a PBL-based teaching model grounded in the OBE philosophy and implement this model in the context of "Logistics Information Management" in vocational education. The primary objectives of this study are as follows:

(1)To review and synthesize the current state of research on OBE and PBL, both domestically and internationally. The study also employs surveys and interviews to assess the existing teaching practices and student learning conditions in vocational colleges, identifying the current challenges and gaps.

(2)Based on a thorough analysis of relevant theoretical frameworks and empirical findings, the study divides the teaching process into three phases: pre-class, in-class, and post-class. A PBL-based teaching model aligned with OBE principles is then designed. This framework will guide the teaching design of the "Logistics Information Management" course, focusing on pre-class instructional planning, the in-class learning process, and post-class assessment strategies.

This research seeks to contribute to the academic discourse on integrating OBE and PBL in vocational education, specifically in the context of "Logistics Information Management." The findings of this study aim to provide valuable insights and practical recommendations for the reform of blended learning approaches in higher education, offering a novel pedagogical model that combines OBE and PBL to improve teaching efficacy and student learning outcomes

2. literature review

Problem-Based Learning (PBL) and Outcome-Based Education (OBE) are two widely adopted pedagogical approaches in contemporary higher education. PBL emphasizes student-centered learning through the resolution of real-world problems, while OBE focuses on ensuring that students achieve specific learning outcomes. This literature review explores the integration of PBL and OBE, particularly in the fields of engineering and other STEM disciplines, and examines how the combination of these two approaches can enhance educational quality and student outcomes.

2.1. Problem-Based Learning (PBL)

Problem-Based Learning (PBL) is a student-centered instructional method that promotes learning through the solution of complex, real-world problems. Ahern (2010) argues that PBL helps students develop critical thinking, teamwork, and problem-solving skills by engaging them with authentic, challenging problems. Borrego et al. (2014) suggest that PBL enables students to apply knowledge in interdisciplinary contexts, which is especially beneficial in engineering education, where students must solve multifaceted problems.

Balve et al. (2017) explored the application of the Kanban method in PBL for a manufacturing engineering project, finding that it enhanced students' project management skills while ensuring that the course's learning objectives were met. Additionally, PBL facilitates self-reflection and deeper learning, which are vital in fields like engineering where practical application of knowledge is crucial.However, the implementation of PBL is not without challenges. Chowdhury (2016) points out that while PBL promotes critical thinking and creativity in engineering students, cultural and institutional barriers to traditional teaching methods may hinder its adoption, requiring teachers to invest more time and effort in curriculum redesign.

2.2. Outcome-Based Education (OBE)

Outcome-Based Education (OBE) is an instructional model that focuses on clearly defined learning outcomes and ensures that students achieve the desired knowledge, skills, and competencies by the end of the course. According to Asim et al. (2021), OBE emphasizes measurable learning outcomes and serves as a framework for designing curricula and assessing student performance. The key advantage of OBE is that it provides transparency, ensuring that both students and instructors are aligned in their understanding of the expected outcomes.

OBE also offers clear guidance on assessment methods, making it easier to track students' progress toward achieving specific educational goals. Ojaleye and Awofala (2018) highlight that OBE ensures that students are continuously progressing toward the achievement of predetermined competencies, making it especially useful in higher education and vocational training.However, OBE faces challenges in its implementation, particularly in aligning course content with explicit learning outcomes and in designing assessments that truly measure the attainment of those outcomes. Dobson and Bland Tomkinson (2012) argue that OBE helps enhance education quality by ensuring that students are assessed based on their ability to meet learning outcomes, rather than just through traditional exams or classroom participation.

2.3. The Integration of PBL and OBE

The combination of PBL and OBE offers a powerful framework for enhancing education. PBL drives deep learning and competency development through real-world problem-solving, while OBE ensures that students meet specific, measurable learning outcomes. Hernandez et al. (2015) describe the Aalborg University PO-PBL model, which integrates PBL and OBE, focusing on both student-driven problem-solving and the achievement of clear learning objectives.

In engineering education, the integration of PBL and OBE is particularly effective, as it connects student learning with real-world engineering challenges. Garcia-Robles et al. (2009) applied e-learning tools to support PBL in computer engineering, ensuring that students could demonstrate their knowledge and skills through practical projects. Their research shows that the use of technology can enhance the integration of PBL and OBE, particularly in disciplines like computer engineering that heavily rely on technological tools.Redkar (2012) points out that while PBL effectively supports the teaching of complex subjects like advanced vehicle dynamics, it requires diverse assessment methods, such as project reports, team collaboration, and peer reviews, to ensure that students achieve the learning outcomes. This underscores the importance of flexible and varied assessment strategies in integrating PBL and OBE.

Despite the benefits, the integration of PBL and OBE presents several challenges, particularly in terms of curriculum design and assessment. Ribeiro and Mizukami (2004) argue that PBL requires instructors to take on more of a guiding role, which necessitates high levels of instructional design and assessment expertise. For students, PBL demands a shift from passive

ISSN: 1813-4890

learning to active problem-solving, which may be difficult for those accustomed to traditional teaching methods.

Nevertheless, the integration of PBL and OBE also presents significant opportunities for educational reform. By clearly defining learning outcomes and utilizing diverse assessment methods, this combination can help students develop not only technical knowledge but also the critical thinking and problem-solving skills needed in today's complex, interdisciplinary world. Palupi et al. (2020) found that combining PBL with Guided Inquiry Learning (GIL) significantly improved students' writing skills, demonstrating the effectiveness of PBL and OBE integration across different subject areas.

The integration of Problem-Based Learning (PBL) and Outcome-Based Education (OBE) provides a robust framework for modern education, particularly in engineering and other STEM fields. This integration enhances students' innovative capabilities, critical thinking, and teamwork skills, while ensuring that they achieve clear, measurable learning outcomes. However, the implementation of PBL and OBE is not without challenges, particularly in curriculum design and assessment practices. Future research should focus on refining the integration of PBL and OBE to better meet the educational needs across different disciplines and cultural contexts.

3. Survey and Analysis of the Current Status of Course Teaching

A survey was conducted using the questionnaire method to investigate the current status of teaching for the "Logistics Information Management" course from the perspective of vocational college logistics students, their understanding of the PBL (Problem-Based Learning) teaching model, and the OBE (Outcomes-Based Education) educational philosophy, and to summarize the issues existing in teaching. Interviews were also conducted with teachers responsible for the "Logistics Information Management" course to understand their views on the current teaching status of the course, students' recognition of the OBE philosophy and PBL teaching model, and their suggestions for implementing PBL teaching based on the OBE philosophy.

3.1. Selection of Survey Participants

The survey questionnaire randomly selected students from Class 1 and Class 2 of the second-year Modern Logistics Management major at a vocational college in Tongling City as the subjects of the study, with 33 students in each class, totaling 66 individuals. The interviews were conducted with students from both classes who are enrolled in "Logistics Information Management" to gather insights from the teachers on the current teaching status of the course in vocational colleges, as well as the students' understanding of the PBL teaching model and OBE educational philosophy, resulting in a total of 13 questions. The multidimensional design allows for a more comprehensive and clear grasp of the actual teaching situation. The questionnaire was conducted anonymously, without collecting personal information from students, in order to obtain genuine results. The interview outline primarily focused on the current teaching status of the vocational "Logistics Information Management" course, students' understanding of the OBE philosophy, and suggestions for implementing PBL teaching based on the OBE philosophy, encompassing a total of 5 questions.

3.2. Analysis of Survey Results

A total of 60 questionnaires were distributed, and all 60 were returned valid, resulting in a 100% response rate. The analysis of the survey results reveals several key insights regarding the current teaching methods and students' attitudes toward the course "Logistics Information Management."First, 52% of students indicated that the teacher predominantly uses a traditional approach, where knowledge is first explained, followed by practice exercises. However, there is little use of more interactive methods, such as creating real-life scenarios, posing problems, facilitating group discussions, or encouraging independent inquiry. This suggests that the teaching approach is largely based on the "lecture-first, practice-later" model, which is a characteristic of rote learning.When asked about their preference for this teaching style, most students expressed a neutral stance, while a smaller group seemed skeptical. This lack of enthusiasm for the current teaching method points to a potential disconnect between the teaching approach and students' learning preferences. Despite this, a strong majority (76.67%) of students consider the course important, demonstrating that they value the theoretical knowledge and skills it offers. Additionally, 75% of students expressed an interest in the subject, which could serve as a motivating factor for future course reforms.In terms of classroom interaction, 86.67% of students felt that there was insufficient communication between the teacher and the students. Effective interaction is known to enhance students' understanding and retention of knowledge, so this lack of engagement highlights a critical area for improvement. Moreover, 78.33% of students reported difficulty in mastering the content of each lesson, further suggesting that the current teaching methods may not be sufficiently effective in fostering deep learning.Finally, 70% of students expressed a desire to change the existing educational model. This widespread call for reform underscores the need for a more engaging, interactive, and student-centered approach that can better address students' learning needs and preferences.

Using a heatmap to visualize the correlation between teaching activities and student performance is essential. It offers an intuitive and accessible method for analyzing complex data, allowing for the quick identification of which teaching strategies are significantly linked to student outcomes. Analyzing the intercorrelations among teaching activities is a critical aspect of educational assessment. By employing Python to calculate the correlation coefficients across all teaching activities and then plotting a heatmap of this correlation matrix, we can gain insights into these relationships. The heatmap uses color gradients to represent the strength of correlations: red hues indicate strong positive correlations, while blue hues suggest weaker or no correlation. The numerical values on the heatmap range from -1 to 1, with 1 representing a perfect positive correlation, -1 indicating a perfect negative correlation, and 0 signifying no linear relationship.Here's an analysis of the correlations depicted in the heatmap:Final_mark (Final Grade): It shows a strong positive correlation with Question_situation (0.91), indicating that performance on assignments is closely tied to the effectiveness of question situations. There's also a strong positive correlation with case_analysis (0.81). Moderate positive correlations are observed with Discussion, Group_task, Class_test, and Chapter_quiz. In summary, activities such as question situations, group tasks, and discussions exhibit a robust positive correlation with final grades, suggesting that these activities may be effective in enhancing student performance. The low correlation between gender and these variables suggests that gender is likely not a major determinant of academic performance.

Outcome-Based Education (OBE) and Problem-Based Learning (PBL) methodologies are crucial in the "Logistics Information Management" course as they enhance student engagement, problem-solving skills, motivation, and deep learning, all of which are reflected through the correlations between variables in the heatmap. Through these teaching approaches, students not only achieve better academic results but also develop key competencies necessary in the field of logistics information management.In the context of "Logistics Information Management," the OBE model emphasizes a focus on student learning outcomes, which corresponds with the positive correlations between Final_mark (final grade) and other activities such as Homework, Discussion, Group_task, etc., as depicted in the heatmap. The design of these activities should be directly linked to the intended learning outcomes. Assessment and Feedback: Under the OBE model, assessment is continuous and closely aligned with learning outcomes. The high correlation between Final_mark and activities like Homework and Question_situation in the heatmap suggests that these activities can serve as effective

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means of evaluating whether students have achieved the desired learning outcomes.Promoting Student Engagement: OBE encourages active student participation in the learning process. The positive correlations between Discussion and Group_task with Final_mark in the heatmap indicate that students who actively engage in discussions and group tasks are more likely to achieve better final grades.

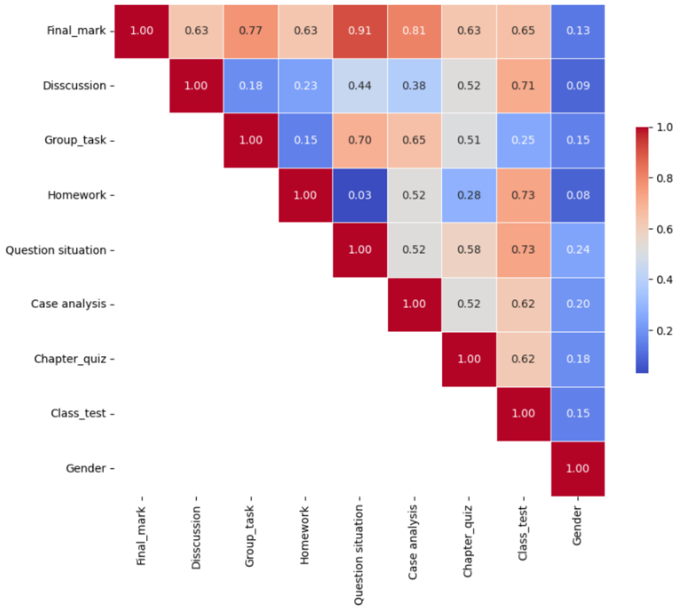

Figure 1 Heatmap of Correlations in Course Grades

Enhancing Problem-Solving Skills: PBL fosters learning through the resolution of real-world problems. The high correlation between Question_situation and Final_mark in the heatmap suggests that learning through problem scenarios can improve students' final grades, likely due to the enhancement of their problem-solving abilities. Strengthening Learning Motivation: PBL can increase student motivation by connecting learning content to real-world issues. The moderate positive correlation between Case_analysis and Class_test in the heatmap may indicate that case analysis, as a method of PBL, can improve students' performance on class tests.Promoting Deep Learning: PBL encourages students to delve deeply into problems, potentially leading to a more profound understanding and learning. The positive correlation between Chapter_quiz and Final_mark in the heatmap may suggest that using chapter quizzes to reinforce knowledge gained during the PBL process can lead to higher final grades for students.

4. Construction of OBE-PBL Teaching Model

Leveraging the Yu Ke Tang (Rain Classroom) platform, the course offers high-quality educational resources. The development of these resources is anchored in Problem-Based Learning (PBL), placing problems at the heart of instruction. By designing challenges with practical application value, the approach stimulates students' interest and initiative in learning. Guiding students to think, analyze, and solve problems fosters their problem-solving skills and innovative thinking.An integrated online and offline teaching platform is established, allowing students to access educational materials, participate in discussions, complete assignments and projects, and engage in real-time communication and interaction with teachers and peers.The Outcome-Based Education (OBE) philosophy provides direction for teaching activities, while PBL offers a method for their design and implementation. The organic integration of these two teaching organizational forms enables students to collaborate in teams to solve real-world problems in the classroom and to develop their critical thinking skills.

Using the OBE educational philosophy, the professional training objectives are determined based on societal and industry needs, the school's positioning, the characteristics of the major, and student development. This approach involves reverse-engineering the curriculum to refine and specify the objectives of each course.PBL project-based teaching is implemented according to the principle of "project leadership and task-driven learning," focusing on real project tasks to positively execute classroom instruction and promote the achievement of course teaching goals.Integrating OBE and PBL into the teaching system can effectively address many of the challenges faced by existing data analysis practice courses.

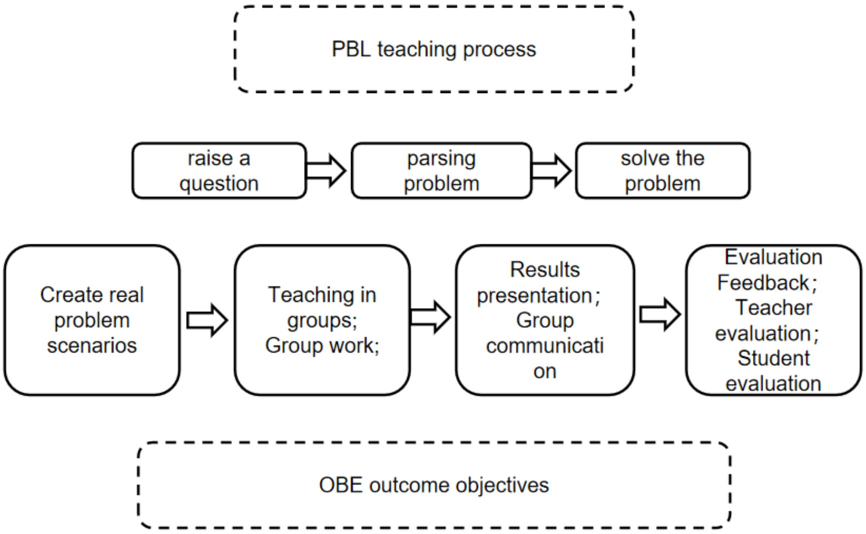

Figure 2 Flowchart of the Integrated PBL and OBE Teaching model

The PBL (Problem-Based Learning) philosophy emphasizes the use of environmental factors and student-centered learning. It highlights group work and places students in real-world scenarios to enhance their ability to solve practical problems. This approach allows students to apply theoretical knowledge of logistics information management to the resolution of actual issues, thereby significantly improving their self-directed learning and critical thinking skills.

The implementation process should include several key steps:

(1) Identifying real-world issues or simulated scenarios in the logistics information management course that can pique students' interest and encourage active participation in the analysis and discussion of practical problems.

(2) Utilizing group learning to gather relevant information and data about the logistics market environment, and collaboratively analyze and discuss solutions to real-world problems.

(3) Establishing a continuous and diverse assessment mechanism to provide comprehensive and ongoing evaluation of students' learning processes.

The course initially applies the OBE (Outcome-Based Education) concept to optimize the design of course content, teaching objectives, and assessment methods. It emphasizes a teaching philosophy that is "student-centered and outcome-oriented." OBE focuses on knowledge acquisition, skill development, and value guidance starting from the student's perspective.Under the guidance of the OBE educational philosophy, the course's learning objectives should be aligned with industry and enterprise demands, in accordance with talent development plans, and tailored to the characteristics of the major and student development. The course should set feasible and innovative learning goals.To achieve these educational objectives, the design of the teaching plan should start with the learning goals and follow the OBE philosophy, with a focus on cultivating students' practical abilities. Building on the OBE philosophy, the course has undergone project-oriented teaching reforms using PBL methods. Real enterprise projects or authentic competition problems derived from data mining serve as the vehicle for these reforms. The projects are localized and the teaching content is further optimized and restructured to align with typical enterprise workflow processes.

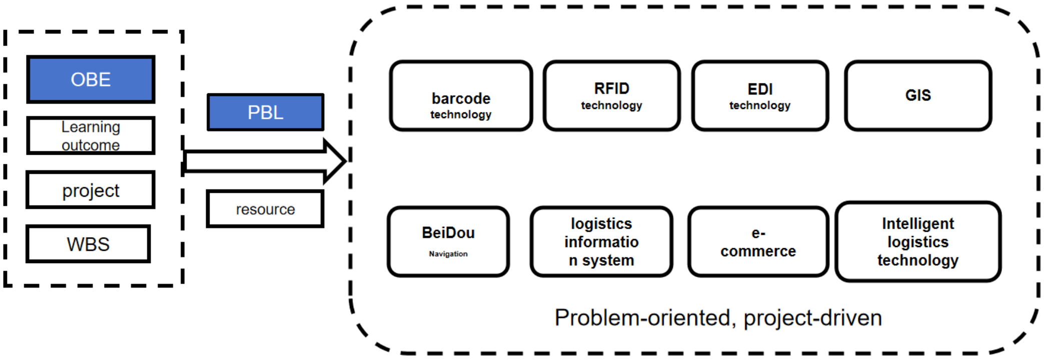

Figure3 Framework of Integrating OBE and PBL in Logistics Information Management Education

Integrating PBL and OBE methodologies, the course in Logistics Information Management is designed to be driven by engineering problems throughout the entire learning process, with a focus on project-based instruction. This approach is structured across three phases: pre-class, in-class, and post-class, to ensure a cohesive educational experience. The hybrid teaching model is designed to enhance the comprehensive implementation of project-based learning within the logistics information management curriculum, emphasizing the integration of industry-academia-research collaboration, a key aspect of modern engineering education, and dedicated to the development of advanced thinking skills. By fostering an environment where students engage with real-world engineering challenges, the curriculum aims to equip students with foundational knowledge and context through online resources and pre-study activities, facilitate in-depth exploration and discussion of these problems in a collaborative setting, and extend learning beyond the classroom through continued project work, application of concepts, and reflection on the engineering problems, with guidance from instructors to consolidate learning outcomes. This model strengthens project implementation, ensures that students are involved in all stages of project management, from planning to execution and evaluation, providing a holistic project management experience, emphasizes industry-academia-research integration, incorporates current industry practices and real-world cases into the curriculum through partnerships, exposing students to the latest advancements in the field, develops advanced thinking skills, challenges students to apply critical, creative, and systems thinking to complex problems, enhancing their cognitive abilities, cultivates practical engineering skills, allows students to apply theoretical knowledge to practical engineering challenges, improving their ability to solve real-world problems, and enhances teaching quality, enabling instructors to monitor student progress and adjust teaching strategies effectively, leading to an improved overall quality of the course. The successful implementation of this model requires instructors to be adept at designing and facilitating project-based learning and to have access to industry connections and resources, and it also demands that students be self-motivated and capable of working collaboratively in team setting.

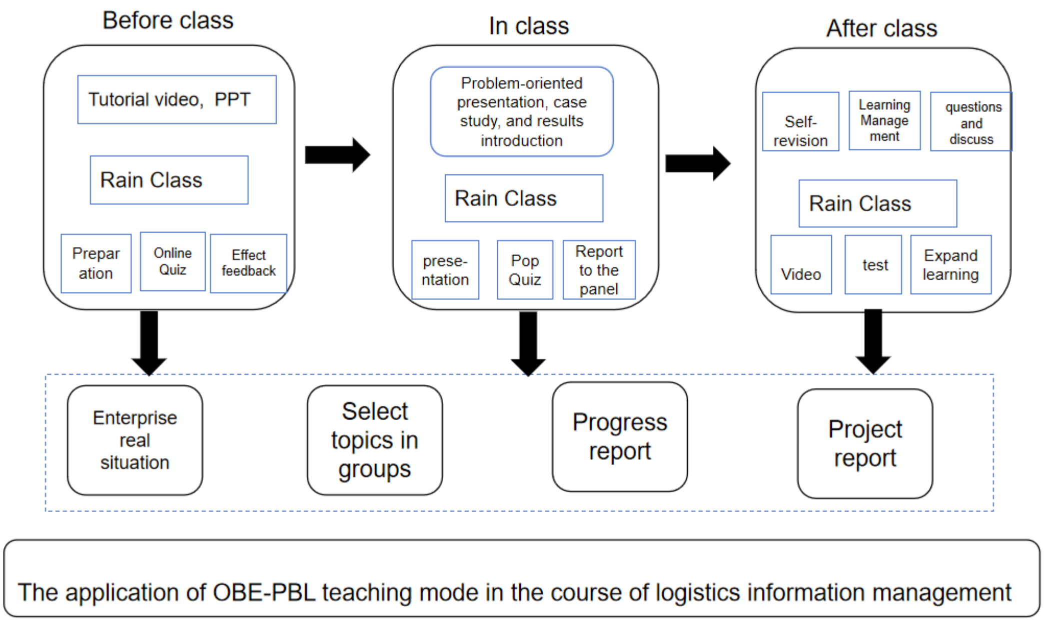

Figure 4 OBE-PBL Blended Teaching Process Flowchart in Logistics Information Management Course

5. The Effectiveness of OBE+PBL Course Practice Teaching Implementation

The study selected students from two classes in the Modern Logistics Management major at Anhui Industrial Vocational and Technical College in Tongling City as research subjects. Class 1, consisting of 33 students, implemented traditional teaching methods and served as the control group; Class 2, also with 33 students, implemented Project-Based Learning (PBL) and served as the experimental group. For quantitative data that conform to a normal distribution, the mean ± standard deviation was used for representation, and intergroup comparisons were made using the t-test. Categorical data were expressed as frequencies or percentages (%), and intergroup comparisons were conducted using the chi-square test or Fisher's exact probability test. A p-value of less than 0.05 was considered to indicate statistically significant differences. When comparing the baseline characteristics of the experimental and control groups, there were no statistically significant differences in terms of gender composition, age, or geographical distribution ($P > 0.05$).

5.1. Comparison of Scores between Experimental and Control Groups

The examination results following the course completion revealed that the experimental group scored significantly higher in both theoretical and practical skill assessments compared to the control group. The experimental group's theoretical assessment scores averaged 90.32 ± 1.28 points, and their practical skill assessment scores averaged 93.58 ± 2.39 points. In contrast, the control group's theoretical assessment scores were 86.32 ± 1.57 points, and their practical skill assessment scores were 86.39 ± 2.62 points. These disparities were statistically significant ($P < 0.05$).

Table 1 Comparison of Final Grades between Experimental and Control Groups (±s, points)

Item	Experimental Group (N=33)	Control Group (N=33)	Statistical Value	P Value
Theoretical Knowledge	90.32±1.28	86.32±1.57	11.3436	<0.001
Practical Skills	93.58±2.39	86.39±2.62	11.6468	<0.001

5.2. Evaluation of the Teaching Process by the Experimental and Control Groups

After the course, both groups of students completed a survey to evaluate the teaching process. The results indicated that the experimental group's scores were significantly higher than those of the control group across five key areas: teaching content, teaching methods, teaching effectiveness, teaching ability, and teaching attitude (P<0.05). This suggests that the implementation of the PBL and OBE approach in the experimental group had a positive impact on various aspects of the learning experience, leading to higher satisfaction and perceived quality of instruction compared to the traditional teaching methods used in the control group.

Table 2 Comparison of Teaching Process Evaluation between Experimental and Control Groups (x±s, points)

Item	Experimental Group (N=33)	Control Group (N=33)	Statistical Value	P Value
Teaching Attitude	22.21±0.37	20.47±1.01	9.2926	<0.001
Teaching Content	23.93±0.56	21.87±0.26	19.1667	<0.001
Teaching Effectiveness	23.36±0.59	21.32±0.34	17.2095	<0.001
Teaching Methods	23.88±0.64	22.36±0.24	12.7747	<0.001

6. Conclusion

In response to the increasing demands for practical and comprehensive skills in the logistics industry, higher education reform and innovation must focus on cultivating students' abilities to meet the evolving needs of the era. This paper integrates the PBL&OBE philosophy into the practice of logistics information management courses, combining real-world resources and market environments with classroom teaching to enhance students' integrated practical skills and professional logistics literacy. The course objectives are designed in a multidimensional manner, with a student-centered, reverse-engineered teaching model that leverages diverse teaching methods and internet resources to foster students' abilities to independently gather information and address real-world problems. In line with these objectives, students are encouraged to engage in comprehensive learning, and a diverse, dynamic, and continuous assessment model is designed to accurately reflect the extent to which classroom teaching meets the course objectives. The incorporation of hot topics and case studies effectively addresses the outdated content and disconnect from practice often found in logistics information management courses. A comparative study was conducted in two classes of a modern logistics management major at a vocational college in Tongling, with one class serving as the experimental group and the other as the control group. The study aimed to validate the effectiveness of PBL teaching models based on the OBE philosophy in vocational logistics information management education. Pre- and post-surveys were conducted to assess the impact of this teaching approach. The results indicated that the application of PBL teaching models based on the OBE philosophy in vocational logistics information management education contributes to the development of students' problem-solving and innovative abilities, providing a more enriching learning experience.

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