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Research and Exploration on Teaching Reform of Computer Major Courses Based on the Integration of OBE and PBL—Taking Dynamic Website Development Course as an Example

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Abstract: In the era of rapid technological advancements, the cultivation of students' practical abilities and innovative thinking has become a key objective in higher education. Developing "New Engineering education" is proposed by the Ministry of Education of the People's Republic of China. To address various issues present in the current Dynamic Website Development course teaching, the curriculum content system based on OBE-PBL integration was developed. This paper reforms and innovates the course in terms of curriculum objectives, teaching content, teaching methods and teaching effects. The research integrates the ideological and political elements to the process of teaching which can improve teachers' and students' the knowledge, ability and ideological realm. The multi-tiered project-based framework was designed to align with OBE principles, gradually transitioning students from mastering foundational knowledge to tackling comprehensive team-based projects. "OBE + Multidimensional" assessment strategies were reformed to provide timely, multidimensional feedback, fostering self-directed learning. This research highlights the feasibility and effectiveness of combining OBE and PBL in dynamic website development, showcasing improvements in students' professional competencies, critical thinking, and ability to address complex engineering problems. The results also serve as a reference for the reform and innovation of computer science education in the context of emerging engineering disciplines.

1. Introduction

Developing "New Engineering education" in order to response the opportunities and challenges faced by advanced engineering education is proposed by the Ministry of Education of the People's Republic of China[1]. The core of New Engineering Education is enhancing students' ability to solve practical engineering problems and it refers to the emphasis on interdisciplinary integration in

engineering education, highlighting the cultivation of practical abilities and the spirit of innovation and entrepreneurship. Under the background of new engineering construction, how to upgrade and improve traditional computer courses is major problem of college educators.

For computer science students, to enhance the effectiveness of course learning and students' innovative capabilities in engineering practice, the computer curriculum is expected to be more practical than theories overridden, which helps the student learn the real-world application skills.

2. Current Problems of Dynamic Website Development

Dynamic website development course provides a comprehensive introduction to the technologies and tools used in building interactive and dynamic websites. As a specialized course in dynamic website development, there are still many issues in its teaching.

(1) Dynamic website development technology covers a wide range of subjects such as HTML, CSS, Javascript, server-side programming, database management, and so on. The knowledge of the course is relatively scattered, and the practical requirements of the course are relatively high.

(2) The knowledge of dynamic website technology involves subjects such as 'Computer Networks', 'Principles and Applications of Databases', and 'Java Programming'. Students not only need to master the foundational knowledge of different disciplines but also need to actively integrate and apply knowledge from multiple disciplines.

(3) The total class hours for dynamic website development are 56 hours, of which 24 hours are for practical sessions. In the theoretical class hours, teachers need to explain foundational knowledge and demonstrate teaching case code; in the practical class hours, students have very limited time for comprehensive case exercises beyond basic case practice, making it difficult for them to master comprehensive foundational knowledge and receive adequate practical training.

(4) The teaching format is relatively monotonous, leading to low student motivation. Moreover, the exercises use simple experimental cases that do not reflect the full content of the course, resulting in students not receiving comprehensive and in-depth training, which leads to a lack of innovative ability.

(5) The interaction between students and teachers is limited, making it difficult for teachers to provide timely feedback on students' work in class, which leads to low student motivation during classroom instruction.

(6) The allocation of teaching resources is suboptimal. There is a shortage of more complex and comprehensive cases, as well as effective mechanisms for execution, supervision, and evaluation. These issues have resulted in unsatisfactory teaching outcomes.

3. Introduction to OBE and PBL

Outcome-Based Education (OBE) is an educational pedagogy that that focuses on the outcomes of student learning. The curriculum is designed around the learning outcomes that students are expected to achieve, and assessment tools are used to measure whether or not students have met those outcomes[2].The teaching content designed under the OBE concept does not focus on students' attitudes towards learning but rather on enabling students to learn how to flexibly apply knowledge[3]. The courses designed under the OBE concept encourage educators to integrate teaching content, optimize curriculum design, adopt diverse teaching strategies, and implement various assessment methods to enhance the quality of education. OBE approach provides valuable guidance for educational reform in computer science programs in higher education institutions[4].

Problem Based Learning(PBL), has been applied to the teaching of computing, aiming to promote collaborative and motivating learning, based on problem solving[5]. PBL method is students-centered differs from the traditional model of education, which is teacher-centered. In PBL,

learning revolves around the discovery of ideas, sparking students' curiosity. This approach encourages them to ask questions, think critically about challenges, and actively solve problems, rather than simply receiving and memorizing knowledge. Due to the differences in training objectives compared to research-oriented talent cultivation, the curriculum content of application-oriented undergraduate institutions is designed to closely align with the enterprises' practical needs. PBL uses real-life practical problems to initiate the learning process so that students gain sufficient practice for the labor market.

The design of computer science curriculum requires both problem-oriented and outcome-oriented approaches, which are independent yet interrelated. The pursuit of outcomes guides the discovery, analysis, and resolution of problems, while the process of discovering, analyzing, and solving problems inherently leads to outcomes. Teachers should not focus on exploring problems without considering the pursuit of outcomes, nor should they pursue outcomes without delving into the problems themselves. The two aspects complement and support each other, forming an inseparable relationship [6].

4. Teaching Process Design

Dynamic websites are a cornerstone of most modern businesses, from e-commerce to online content platforms. Graduates of computer science can apply for a range of roles, including web developer, front-end or back-end developer, and full-stack developer. As an application-oriented undergraduate institution, Haojing College of Shaanxi University of Science&Technology offers the web development program comprising two components: the professional course "Dynamic Website Development" and an employment training project focused on Java web development. The professional course provides students with the foundational knowledge and skills required for website development, which serve as the basis for more advanced topics in Java web development during the training project.

Based on a teaching model that combines OBE (Outcome-Based Education) and PBL (Problem-Based Learning), this paper conducts research and exploration on teaching reform for the Dynamic Website Development course for undergraduate computer science students at the Haojing College of Shaanxi University of Science&Technology, China. The research focuses on five aspects: redesigning teaching objectives, promoting in-class and extracurricular practical teaching content, enhancing teaching methods, establishing an outcome-based assessment mechanism.

4.1 Teaching Objectives

Under the OBE teaching framework, the teaching objectives of the curriculum must be guided by the principle of curriculum ideology and politics, following the important concept of educational transformation in the 'New Engineering' initiative. These should not only include foundational knowledge and skills required for Java web development training project, but combine the latest technologies in the industry and align with the school's requirements for professional talent cultivation. The teaching objectives should be specified in four aspects: knowledge, skills, attitudes, and ideological education, as shown in Table 1.

Table 1: Teaching Objectives

Knowledge Objectives	HTML, CSS, Javascript, server-side programming technology, database management technology.
Skill Objectives	(1) Be able to design website,implement layout and interaction function; (2) Be able to validate form data on the server side,understand how to connect to and access to the database; (3) Be able to analyze professionally and solve practical engineering problems.
Attitude Objectives	(1) Cultivate students' rigorous, meticulous, and serious learning attitude; (2) Foster students' spirit of cooperation, as well as their abilities in coordination and organizational management; (3) Encourage students to pay attention to the development trends and application prospects of the discipline, emphasizing the cultivation of their exploratory spirit towards new technologies; (4) Cultivate students' logical thinking, analogical thinking, and innovative thinking, enhancing their professional knowledge quality and laying a solid foundation for learning subsequent courses.
Ideological and Political Objectives	(1) Focus on cultivating high-level professionals with social responsibility and innovative spirit for practical applications; (2) Foster technology talents who are law-abiding and possess noble character; (3) Guide students to pay attention to social realities and practical issues in enterprises, cultivate their correct worldview, outlook on life, and values, and develop an awareness of actively assuming social responsibility, using their intelligence to contribute to the construction and service of the country.

4.2 Teaching Content

In order to achieve the teaching objectives of the dynamic website development course, the design of the teaching content should follow the OBE teaching philosophy, and focus on cultivating students' practical abilities. The Dynamic Website Development course not only needs to cover fundamental technical knowledge but also incorporate cutting-edge technologies from the industry and profession, such as front-end and back-end frameworks. By integrating the Project-Based Learning (PBL) approach, Multidisciplinary integration involves introducing the W3Schools teaching platform. As shown blow, the teaching content of the Dynamic Website Development course is divided into four stages, progressing from basic to advanced, covering front-end to back-end development.

- First stage: Fundamental knowledge;
- Second stage: HTML, CSS, Javascript;
- Third stage: Front-end Framework, Back-end Framework;
- Fourth stage:Database;

Designing problems based on projects and integrating ideological and political education into the project content. The projects are divided into four levels (I, II, III, IV) according to their difficulty.

- Level I Project: This is primarily focused on learning basic knowledge, involving relatively few concepts, helping students master fundamental knowledge. It is designed to give students a sense of achievement and motivate them to continue learning.
- Level II Project: After learning a specific topic in the same phase, students complete a more comprehensive project. For example, after learning HTML, students are required to create a basic

web page; after learning CSS, they must use CSS to layout the web page, etc.

● Level III Project: After completing a phase, students use the knowledge to complete a comprehensive project. For example, after the second phase, students could develop a static website.

● Level IV Project: This level involves more complex projects that require database connection and access, such as developing an e-commerce website.

These four stages progress from basic to advanced, gradually shifting from teacher-centered to student-centered, and progressively developing students' problem-solving abilities.

4.3 Teaching Model Implementation

The traditional "Web Dynamic Website Development" teaching model follows a lecture-based approach, where the teacher dominates the class, delivering professional knowledge. The students lack sufficient practice, which affects their ability to solve real-world problems. Therefore, the teaching model of the "Web Dynamic Website Development" course must be reformed by following the OBE concept and applying the PBL approach. .

(1) **Expanding High-Quality Resources in the Online&Offline Teaching Platform.** The teaching implementation follow the principle of "student-centered, teacher-guided", and the teaching process is divided into three major stages: pre-class (online), in-class (offline), and post-class (online), as shown in Table 2.

Table 2: Teaching process

Session	Main Task		platform
	Teachers	students	
Pre-class	● plan and design pre-class teaching resources and plans; ● analyze students' feedback of their pre-class learning to prepare for in-class session;	● preview the content of the lesson ● complete pre-class tests, and surveys	W3Schools; MOOC; Rain Classroom platform;
In-class	● guide students through the analysis of project cases; ● encourage them to complete Level II and Level III project cases;	● work with group members to complete practical tasks	Off-line
Post-class	● supervise students to complete the post-class assignments ● complete Level IV project cases	● complete post-class assignments, evaluating and reflecting; ● work with group members to Level IV project	Rain Classroom platform;

(2) **Team Collaboration to Inspire Students.** The Dynamic Website Development course operates through group collaboration, with cooperative discussions. The course is problem and task-oriented, focusing on student-centered learning, emphasizing outcome-based results, and encouraging independent thinking while promoting mutual support among students.

(3) **Application of the PBL Teaching Approach in the Course.** Projects are designed at different levels of difficulty. Projects of varying difficulty levels enable students to receive both real-time and periodic feedback. Simple projects is primarily on learning basic knowledge, covering

a limited number of key teaching points. It is helpful that students are motivated to continue learning. Comprehensive projects can motivate students to enhance their self-directed learning abilities.

(4) **Learning and Teaching through Competition.** This refers to integrating various competitions into the teaching process, using competition results to assess students' actual abilities, enhance their professional skills, and reinforce the knowledge they have learned.

4.4 Evaluation Framework

Based on the concept of "OBE + Multidimensional System," an OBE + Multidimensional teaching effectiveness evaluation framework is adopted, which involves the combination of various evaluation dimensions: evaluation subjects, evaluation methods, evaluation timing, and evaluation content, as shown in Table 3.

Table 3: OBE + Multidimensional System

evaluation subjects	self-evaluation, group evaluation, teaching assistant evaluation, and teacher evaluation
evaluation methods	online and offline tests, surveys, interviews, presentations, and more
evaluation timing	Attendance, learning notes, programming code, presentation, tests, Q&A and discussions, and results from subject-related competitions
evaluation content	periodic evaluations, project evaluations, and midterm evaluations

5. Analysis of Teaching Effect

5.1 Enhancing Students' Autonomous Learning Ability

In the classroom, real-world problems are integrated into learning task based on projects. The projects are designed at different levels of difficulty to enhance students' practical abilities progressively. Level I projects help students master basic knowledge, giving them a sense of accomplishment and motivating them to continue learning. Level II projects assess students' understanding of the subject matter. Level III projects require students to complete comprehensive, multi-subjects integration projects, developing their comprehensive abilities. Level IV projects are group-based, focusing on strengthening students' teamwork skills. The varying levels of difficulty allow students to flexibly master professional knowledge, further enhancing their self-learning capabilities.

5.2 Enhancing Teachers' Innovative Ability

The integration of the OBE-PBL teaching model in the Dynamic Website Development course requires teachers to understand the necessity and importance of cultivating students' practical application abilities. The teachers not only gain the foundation knowledge of Dynamic Website Development, but also gain the professional knowledge of front-end framework, back-end framework and database connection. The teachers gain opportunities to innovate, enhance their instructional methods, and stay updated with new teaching practices and technologies.

5.3 Enriching Teaching Resources

The course integrates multiple disciplines, and the teaching process is not limited to any single textbook. The W3Schools online teaching platform is used as a primary teaching resource to assist

students in completing tasks. Additionally, teaching PPTs, resources from the MOOC platform, pre-class quizzes, and other materials are uploaded to Rain Classroom. Those allow students to learn at their own pace, choose topics of interest, and receive instant feedback.

5.4 Bridging Theory and Practice

Following the PBL teaching model, the course designs project requirements to assist students in formulating project plans and engaging in practicing and group collaborative learning. The course emphasizes outcome-based results and encourages students to participate in computer design competitions, such as Chinese Collegiate Computing Competition, Lanqiao Cup and so on. Participating in competitions helps students not only acquire interdisciplinary knowledge but also enhances their innovative thinking, and problem-solving abilities. Curriculum updates aligned with industry trends prepare students for the demands of the modern workforce.

6. Conclusion

In summary, Integration of OBE and PBL concept has certain feasibility and necessity in the teaching of the "Web Dynamic Web Design" course. The course in dynamic website development equips students with a well-rounded skill set in web technologies, problem-solving, and creative design, preparing them for a career in web development or related fields. Additionally, it ensures students are well-prepared for the demands of modern web applications. OBE+PBL teaching model into the Dynamic Website Development course has effectively stimulated students' enthusiasm and initiative for learning. It inspires students and enhances their innovative thinking. After reformed, the course bridges theory and practice to develop students' ability to analyze and solve real-world engineering problems. It helps students advance in their careers.

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