Research on the Teaching of Large Database Application Techniques Course Based on OBE

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Abstract: This paper addresses the problems in the current teaching of large database application techniques course, such as teacher-centered instruction, an overemphasis on theoretical knowledge, and inadequate evaluation methods. To improve the teaching quality, the Outcome-Based Education (OBE) concept is introduced. The reform focuses on setting clear course objectives, optimizing course content, and transforming teaching methods and assessment strategies. A blended teaching model that combines online and offline learning is implemented, alongside with a diversified evaluation system that integrates both process-based and final assessments. Practical implementation has demonstrated that the OBE-based approach enhances students' active participation in their learning process, strengthens their autonomous learning and engineering practice abilities, and significantly improves the quality of training for application-oriented engineering professionals.

Keywords: Large Database Application Techniques; OBE; Teaching Reform; Blended Teaching Method; Diversified Course Evaluation

1. Introduction

The course on Large Database Application techniques is an important elective for computer science-related programs at our university. It focuses on Oracle Database, a leading example of large-scale database management systems. Oracle database is renowned for its powerful data management capabilities, high reliability and security. It is widely used in many applications, such as telecommunications, finance, energy and healthcare. The course aims to equip students with fundamental knowledge and skills related to Oracle database management, maintenance and application development, laying a solid foundation for their future careers in database-related fields.

An analysis of the current teaching of the course reveals several key problems:

First, the course follows a traditional teacher-centered approach. The teachers act as the primary source of knowledge, delivering lectures and assigning tasks. The students passively listen, absorb information and complete assignments. This approach limits students' active engagement and initiative, hindering their ability to take ownership of their learning experience.

Second, the course places a disproportionate emphasis on theoretical knowledge, such as the basic concepts, principles and specifications of Oracle Database. While this is important, there is insufficient focus on practical application. For instance, when introducing the stored procedure, substantial time is dedicated to teaching the basic syntax and parameters. The cases that require students to apply this knowledge in practice are lacking. As a result, students struggle to adapt theoretical concepts to solve real-world engineering challenges.

Lastly, the course's evaluation system is underdeveloped. Currently, assessments are primarily based on a final exam, with limited attention given to students' ongoing performance throughout the course. The focus of the exam is largely on Oracle database's basic concepts, while the problem-solving abilities and practical skills of students are not adequately assessed. This makes it difficult for teachers to evaluate the learning result from a comprehensive and multi-faceted perspective.

2. Curriculum Instruction Based on OBE

Outcome-Based Education (OBE) is a structured model which organizes, implements and evaluates education based on expected

learning outcomes. It is also known as competency-based education, goal-oriented education, or needs-driven education [1,2]. OBE is a core principle of engineering education. In 2016, China officially became a signatory to the Washington Accord, marking the international mutual recognition of its engineering education programs. This has raised the crucial issue of how to implement OBE in engineering education to enhance the quality of student training, a topic of significant attention for universities across China. The OBE approach emphasizes a student-centered, outcome-driven and continuously improving educational model. Under this framework, instructors must first define clear course objectives and the expected learning outcomes for students. Based on these outcomes, they should design the course content, teaching methods and assessment strategies to ensure alignment. During the course delivery, teachers are encouraged to monitor students' progress closely, enabling timely adjustments and improvements to the teaching content and methods.

To tackle the problems described above, the OBE concept is introduced to reform the teaching of Large Database Application techniques course. The reform is builded upon the analysis of existing researches on database course reforms[3-9]. The goal is to foster a more active and efficient learning environment, driving students to take greater ownership of their educational journey.

2.1 Setting Course Objectives

The training objectives and graduation requirements of the program are established based on the workforce demand in the software industry and the university's goal of cultivating application-oriented talent. They serve as the foundation of formulating course objectives. The objectives focus on three key areas: knowledge, skills, and professional competencies.

In terms of knowledge, students are required to acquire a thorough understanding of fundamental concepts, principles and methods associated with Oracle database architecture, management and application development.

In terms of skills, students should be capable of applying the learned techniques to develop application systems based on Oracle databases, as well as accomplish basic database management and maintenance tasks.

Finally, in terms of professional competencies, students are expected to uphold engineering ethics, adhere to professional standards, and demonstrate the ability to collaborate effectively in team settings.

2.2 Optimization of Course Content

In order to align with the course objectives, the curriculum content has been adjusted and optimized. The focus is placed on enhancing the relevance and practicality of theoretical knowledge while emphasizing engineering practice. The revised course structure is organized as follows:

1) Overview of Oracle Database: This part introduces the Oracle database, including the process of installing and uninstalling the software. It also covers the use of key management and development tools such as SQL*Plus and PL/SQL Developer.

2) Storage Structures: This part covers both physical and logical storage structure of the database. For the physical storage structure, the data file, the control file and the log file are primarily introduced. For the logical storage structure, the tablespace is primarily introduced.

3) Database Instances: This part covers the concept of database instance and its composition, as well as the procedures for starting and shutting down a database. A basic introduction to Oracle's main memory structures and background processes is provided. In-depth explanations of the principles and mechanisms will be offered as supplementary material for students to study independently.

4) Schema Objects: This part covers the concept of schema and the management operations of essential schema objects, including tables and indexes. Additional schema objects, such as partitioned tables and views, are presented as extra study material for students to explore outside of class.

5) Security Management: This part covers the concepts, types and management of users, permissions and roles within the database. Other security mechanisms, including initialization files and auditing, are introduced as optional content for further self-study beyond the class sessions.

6) Database Backup and Recovery: This part covers the concepts of database backup and

recovery, the basic methods for physical backup and restoration, along with the method of importing and exporting data.

7) PL/SQL Programming: This part includes essential knowledge on PL/SQL language, such as the use of cursors, and the writing and execution of stored procedures and triggers. This content is closely linked to SQL, which is a key topic in the prerequisite course on database fundamentals that students have already mastered. Consequently, the Large Database course does not revisit basic SQL, but rather integrates it into the PL/SQL programming lessons. For instance, basic SQL tasks are included in pre-class quizzes, and complex query functionalities are incorporated into case studies where students design PL/SQL programs. This encourages students to revisit and solidify their SQL knowledge while learning PL/SQL.

2.3 Reform of Teaching Methods

The current teaching methods are being reformed through the adoption of a blended learning approach. This approach organically combines traditional in-person teaching with online learning platforms, maximizing the strengths of both classroom and online learning environments. The aim is to foster active learning, exploration, and discovery by students[10,11].

The teaching process is divided into three distinct phases: pre-class learning, in-class learning, and post-class learning. Students are required to complete tasks in each of these phases, while teachers analyze and evaluate their progress. The blended learning framework is illustrated in Figure 1.

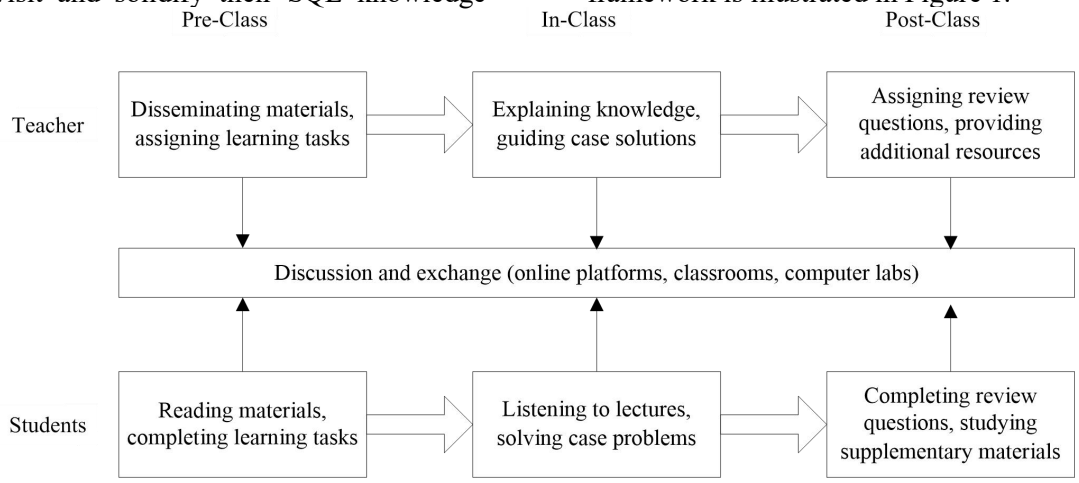

Figure 1. Design of the Blended Teaching Plan

In the pre-class learning phase, teachers disseminate study materials and tasks according to the teaching objectives and content. The materials primarily consist of slides and documents that introduce the key points of the subject matter. For more complex or difficult-to-understand topics, corresponding instructional videos are created to aid student comprehension. In addition to reading the study materials, students are required to complete practical exercises. These exercises are simplified adaptations of examples found in the materials, helping students become familiar with basic operational steps and the syntax of related commands. If students encounter difficulties, they can resolve them through peer discussions or by consulting the teacher. Teachers collect students' questions, analyze them and identify common issues for further discussion.

During the in-class learning phase, teachers address the common issues identified from the pre-class study and provide additional explanations and demonstrations of other key topics. Afterward, teachers present case studies, which students solve through group collaboration. Teachers provide guidance throughout the process. These case studies are designed based on real-world engineering projects, which are incorporated into the entire course curriculum. Based on the current topics being taught, teachers select relevant components from the projects for modification, thereby enhancing students' awareness and abilities in engineering practice. For well-performing groups, teachers may ask them to present their results and explain their approach in front of the class.

In the post-class learning phase, teachers assign review questions to reinforce the

knowledge and methods learned in class. Additionally, extended learning materials may be provided, extending the depth or breadth of the course content. Students are encouraged to select materials based on their learning abilities and interests. Teachers are available online to assist students with any questions that arise during their studies.

As an example, consider the management of Oracle tables. Key topics in this part include creating tables, managing table constraints and modifying or deleting tables. In the pre-class phase, teachers release materials that introduce these concepts, along with example codes and expected results. In terms of tasks, teachers assign practical exercises related to table management. Students complete these tasks while learning the materials, and teachers gather common questions for analysis. Typically, issues arise in the areas of logical structure design and physical parameter settings during table creation. These issues are addressed in detail during the in-class session. Teachers may also briefly introduce other related topics, such as querying table information. Following this, a case study is introduced: students are tasked with designing the logical structure of data tables based on the Entity-Relationship diagram for a small information management system. They should also set storage parameters and create the tables. This case study integrates both Oracle table creation knowledge and database design methods from a prerequisite course, offering a more comprehensive challenge. Students work in groups to discuss and solve the case, with the teacher providing feedback. For post-class learning, teachers assign review tasks related to table management, with a level of complexity equal to or greater than the case presented in class. These tasks may involve more complex E-R diagrams or require students to analyze and optimize their designed structures. Additionally, teachers provide materials on the management of other types of tables, such as partitioned tables and external tables, to encourage further study and exploration.

2.4 Diversified Course Assessment

To achieve a comprehensive evaluation of students' learning outcomes, a diversified assessment approach is adopted in the course, integrating both process-based assessment and final assessment. The final assessment takes the form of group projects. The students are asked to develop application systems based on Oracle database. Students can either choose from topics provided by the teacher or select their own. The focus of the assessment is on evaluating students' ability to comprehensively apply the knowledge and methods they have learned to design and implement databases. The assessment grade is determined based on the completion of the project and the results of the defense. Process-based assessment evaluates students' performance throughout the entire learning process. This includes the completion of pre-class quizzes and post-class review questions, class participation, and the completion of laboratory assignments. It primarily assesses students' learning attitude, mastery of fundamental knowledge, and the ability to apply what they have learned. Through such evaluations, potential issues in the teaching process can be identified, allowing for timely adjustments and improvements in teaching activities.

3. Conclusions

To address the problems in teaching Large Database Application techniques course, the OBE framework has been introduced to guide instructional reform. The course content has been optimized in alignment with specific learning objectives, and both teaching methods and assessment strategies have been restructured. An effective integration of online and offline learning has been implemented, alongside a diversified assessment approach that balances both process-based assessments and final exams. Practical outcomes have demonstrated that the OBE teaching model has successfully fostered greater student initiative and engagement. It has enhanced their ability to learn independently and apply acquired knowledge and skills to solve practical engineering problems. As a result, the quality of applied talent cultivation has been significantly improved.

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