Teaching Reform of Object-oriented Programming Course Based on OBE

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Abstract. In view of the shortcomings of teacher-centered and curriculum content-centered in Higher Vocational education, this paper adopts the results-oriented and student-centered teaching reform model, takes the course of "Object-oriented Programming" in Higher Vocational Computer Specialty as an example, and advances from the aspects of curriculum objectives, teaching design, teaching implementation and teaching evaluation. In order to carry out reform and exploration, we design a set of relatively perfect curriculum achievement indicators system and make continuous improvement. Through the teaching practice of the course, the achievement degree of the course has been greatly improved, and the expected teaching objectives have been achieved, which provides a new way to improve the teaching quality.

Introduction

With the advent of the new industrial revolution led by artificial intelligence, more and more complex social division of labor requires high-quality application-oriented engineers with the ability of interdisciplinary rapid learning, communication and cooperation, and the ability to solve complex problems. In order to meet this challenge, it is imperative for higher education, especially higher vocational education, to change the existing curriculum content-centered, teacher-centered education model. "Outcomes Based Education" was first implemented in the reform of basic education in the United States. After more than ten years of theoretical research and practical exploration, a relatively complete theoretical system has been formed. It has been regarded as the correct direction of pursuing excellence education and has been widely used in higher engineering education. With China's accession to the "Washington Accord" for engineering education certification, the educational concept of OBE has gradually penetrated into all fields of higher vocational education [1-2]. This paper integrates the educational concept and core elements of OBE into the teaching design of the "Object-oriented Programming" course of software technology major, and makes some active exploration on the teaching reform in higher vocational colleges from the aspects of curriculum objectives, teaching design, teaching activities and teaching evaluation feedback, and verifies the effectiveness and operability of OBE model through teaching practice.

The Concept of Outcomes Based Education

The concept of OBE education was put forward by William G. Spady, an American sociologist and educator. The OBE concept of "all students can learn and succeed" emphasizes that the teaching practice should focus on the students' learning results after receiving education; the implementation of teaching should be student-centered and develop students' diversified personalities [3].

According to the students' characteristics and individual differences, we should make individualized evaluation grades, timely evaluation and feedback, accurately find out the students' learning state, timely amend the teaching design and content. These help students obtain good learning experience, achieve success in successful learning, and improve learning initiative and creativity. The core elements of OBE include student-centered, result-oriented and quality
continuous improvement. The result of OBE refers to the core competence, which is not only the learned knowledge, but also the ability to solve practical problems.

Teaching Status of "Object-oriented Programming" Course
"Object-oriented Programming" is a practical foundation course for computer majors. It requires students not only to master the basic syntax and application, but also to understand its application in engineering projects through training. In traditional teaching, teachers usually use the process of explaining theoretical knowledge - > demonstrating practical operation - > assigning tasks - > students practicing - > submitting practice results.

This kind of teaching process seems reasonable and clear, but in actual teaching, it is difficult for teachers to reasonably arrange the time between teaching and students' practice. In the teacher-centered classroom, students are passive acceptance, and cannot choose targeted learning according to their own learning situation; it is difficult for students to integrate knowledge system with their own existing knowledge and ability.

Instructional Design and Implementation for Oriented Outcomes
With the current teaching situation of "Object-oriented Programming" course, the main reasons for students' poor learning results are passive acceptance and weak knowledge coherence. In this curriculum reform, the introduction of results-oriented and the reasonable objectives are provided at the course beginning, so students have a clear learning results of the course.

Through the study of OBE education ideas and the reform plan of "Object-oriented Programming", this paper designs the course learning objectives, implementation and learning evaluation system which conform to the professional training objectives and coordinate with other professional courses. The main contents include:

1. According to the training objectives of software technology specialty and the requirements of employers for graduation ability, the objectives of "Object-oriented Programming" are refined and the expected learning results are designed.

2. According to the designed expected learning results, the teaching content is arranged, and mixed teaching methods is adopted in the course implementation, so as to promote students to achieve learning target.

3. Construct a reasonable and diversified learning evaluation system to objectively reflect the students' learning results, let students find their own problems, feedback the problems, and timely adjust the teaching content and methods.

Determine Course Objectives
"Object-oriented Programming" is a professional foundation course for software technology majors with skillful practicality and applicability. According to the training objectives of the software technology specialty and the professional core competence indicators, the course objectives are refined, and the internal relationship with learning outcomes is improved, at the same time, the relevance of this course to other professional courses is improved.

Through questionnaires on graduates, interviews with employers and industry experts to discuss on job training requirements, the relevance of professional courses to industry development is defined. These help teachers understand the position of this course in the whole professional training system, formulate a more comprehensive expected learning outcomes [4].

Students' behavior data is collected by questionnaire or brainstorming on "Blue Cloud Class" teaching and learning platform before the beginning of this class. These data are used to evaluate students' learning habits and preferences, analyze their learning situation, optimize students' learning results according to their personalized differences, perfect the curriculum objectives, and clarify the supporting details of the curriculum objectives to the core competence indicators. Table 1 lists the expected learning results of the "Object-oriented Programming" course.
Internalization of knowledge
Before class
Transmission of knowledge
Application of knowledge

| No. | Course Objectives | Support for Ability Indicators | Support for Core Competencies |
|-----|-------------------|--------------------------------|-----------------------------|
| 1   | Know well the basic knowledge and development tools of object-oriented programming design, the methods of object-oriented programming, can use object-oriented technology to develop applications. | 1.2 Master skillfully the knowledge and ability for software development, testing and other related majors. | 1. Professional ability |
| 2   | Know well the basic ideas of object-oriented programming, can use object-oriented methods in specific practice, can solve practical problems with development specifications. | 2.1 Master skillfully the theories and methods of programming, possess the ability to analyze and solve problems. | 2. Problem solving |
| 3   | Master the use of object-oriented development tools, and other related tools for software development | 3.1 Master skillfully the use of modern software development techniques and tools to acquire, handle and use information. | 3. Information literacy |
| 4   | Possess the ability to express verbally, to write in the process of software development, to discuss and communicate with teachers and students. | 5.1 Possess the ability to express verbally, write and communicate for professional questions and work well with other team members | 5. Communication and cooperation |
| 5   | Possess the ability to learn related professional knowledge for software development independently, skilled use of various tools or methods to obtain and collate learning materials. | 6.1 Possess lifelong learning consciousness and independent learning ability. | 6. Lifelong learning |

Teaching Implementation Process

The student-centered education concept of OBE requires teachers to change their roles. In the process of teaching implementation, they no longer focus on teaching knowledge, but act as coaches and leaders to guide, motivate students and give them advice to acquire knowledge, solve problems and improve their own abilities [5]. The teaching implementation framework of the flipped classroom as shown in Figure 1 is constructed. The teaching activities are divided into two levels: teachers and students, include three stages: pre-class, in-class and after-class. Each stage contains not only several tasks, but also evaluation throughout. With the help of "Blue Cloud Class" teaching learning platform, teachers can do the teaching activities including delivering resources, assignment, in-class testing and classroom check-in. At the same time, the social function of QQ group helps teachers and students communicate and interact effectively. The timely feedback and encourage put students in a good learning atmosphere, form a sense of group belonging, and improve students' participation and enthusiasm in learning.

![Figure 1. Teaching Implementation Framework Based on Flipped Classroom.](image)
Before class. Teachers upload the preview task list, teaching video and other resources to the "Blue Cloud Class" teaching and learning platform and submit the prototype project code to the GitHub website. The preview task list clearly describes the implementation plan of the class, including the expected objectives, key and difficult points, self-learning contents, programming exercises, time allocation and so on. Students can refer to teaching video for self-learning knowledge points, finish simple programming tasks, and feedback questions that cannot be understood to the "Blue Cloud Class" answer area. Meanwhile any students who give answers will be awarded points, so that each student has the possibility to become a teaching assistant, to get the sense of achievement from the process of helping others.

In class. Pair programming is used in the laboratory, mainly including: First, teachers check the students' preparation in the "Blue Cloud Class" by in-class quizzes or asking some questions. Teachers correct the students' understanding deviation in time, and help students form the habit of previewing. Second, teachers refine the key points and difficulties of the course contents by preview feedback before class, concentrate on the students' main problems, explain the key points through some cases, and help students to understand the difficult contents by several projects, so as to avoid students' misunderstanding in the process of self-learning. Third, students use pair programming to complete the learning tasks autonomously. They can help each other and learn from each other. Teachers help students analyze and locate problems, and create some programming problems to inspire and guide students. At the same time, discussions and cooperation between groups should be encouraged to help each other to solve problems. Fourth, teachers summarize common problems, explain related knowledge points, help students to correct their misunderstanding of knowledge points; analyze and summarize students' classroom performance, and share excellent group results; assign homework including blog, video recording, expand task functions and other forms. These help students achieve information literacy, written expression and other course objectives.

After class. Students review what they have learned through homework, internalize knowledge and construct their own competence framework; students enhance professional skills by expanding tasks, and improve their interesting in professional learning. Teachers summarize the learning problems, review the code submitted by students, give suggestions to promote students' professional abilities. Teachers timely correct and comment on the students’ homework that submitted to the "Blue Cloud Class", face-to-face communication with students who cannot complete the homework, help them to complete the task, establish learning confidence.

Teaching Evaluation

A perfect teaching-learning evaluation system not only reflect the learning effect of students, but also help students to remediate learning by finding their own problems, and promote the achievement of learning outcomes. OBE has formed different levels and different dimensions of evaluation mechanism [6]. This course evaluation is based on the framework of OBE's evaluation system, combines teaching objectives and actual teaching situation, clarifies the composition and proportion of the course outcomes, and formulates a more reasonable evaluation rules.

The course score consists of three parts: ordinary performance, stage comprehensive performance and final examination, accounting for 3:3:4. The ordinary performance includes homework, classroom performance, and class quizzes. Homework is the final results of each unit; class performance includes attendance and the result of answering questions. These activities are published in "Blue Cloud Class" and the teacher completes the ordinary score for every student. In order to find out the students' learning situation in the middle of the course, a comprehensive stage test is organized, and the results will be included in the final score. Final examination which is most important for students includes two parts: basic knowledge points and task coding.

At the end of the course, the teacher gives the final evaluation, and calculates the achievement degree of course objectives for each student and the whole class, and finds out the deficiency, which is the basis of reform and further optimization for the course design. The corresponding relationship is established between the course objectives and the students' evaluation. Table 3 is the assessment and evaluation weight allocation based on OBE.
Table 2. Assessment and Evaluation Weight Allocation.

| Evaluation Stage | Evaluation Contents | Weight (%) | Evaluation Standards |
|------------------|---------------------|------------|----------------------|
| Ordinary Performance | Homework | 10 | Evaluate the completion of homework. |
| | Classroom Performance | 8 | Score according to class attendance, answering questions and so on. |
| | Classroom Quiz | 12 | Score for learned knowledge points |
| Stage Assessment | Comprehensive Test | 30 | Score for learned content. |
| | Final Exam | 40 | Score for final examination |

The Effectiveness of Teaching Reform

A better teaching results is got based on OBE education idea. The comparison of two grades of software major at the end of this course is shown in Figure 2. Class 1621 of software adopts traditional teaching mode and class 1721 of software adopts OBE teaching mode. Although it is difficult to ensure that the exam is of the same degree of difficulty, and the scores are difficult to reflect the true ability, but we can see that the students' scores have a clear trend to improve from the statistics.

![Scores Comparison of Two Classes](image)

At the end of course, 140 questionnaires were sent out and 136 were retrieved. The results showed that most of the students were satisfied with the course, mainly as follows: (1) Teachers and students achieve the common expectations, students fully understand the support of this course on the software major, most students' learning desire, initiative and confidence have greatly improved. (2) Students feel that this learning mode improves their self-learning ability and solving problems ability. (3) Group cooperation will make communication more smoothly and create a learning atmosphere of supervision and help each other. (4) The evaluation of the course is more reasonable and objective.

Summary

The teaching design of the course is constructed based on the results-oriented core idea of OBE, which pays attention to core competence objective, refines course objective, takes student-centered in teaching implementation, fully considers the student's individuality and difference, comprehensively evaluates students' abilities by using pluralistic evaluation indicators. According to the course objectives, we can find the direction of the course optimization, complete the closed loop of the teaching quality improvement, and effectively improve the teaching quality and teaching effectiveness.
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