

Comparative Study of Traditional and OBE Modes in the Experimental Teaching of Water Treatment Experiment and Simulation Technology

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Abstract: The OBE model is a result based education model, which is a new type of education model that emphasizes practical teaching and innovative thinking. The training model meets the needs of today's social development, promotes full employment of college students, and also provides high-tech professionals in various fields for society. However, students cultivated under the traditional education mode cannot fully apply what they have learned in practice and work, resulting in low employment rate or poor ability to adapt to the workplace after employment. This study takes the undergraduate teaching of "Water Treatment Experiment and Simulation Technology" in the Environmental Engineering major at the School of Architecture and Civil Engineering, Chengdu University as an example. By comparing the traditional education model and the OBE education model from the perspective of experimental teaching, this article analyzes the shortcomings of the traditional education model and the advantages of the OBE teaching model, as well as the role of the OBE education model in student work practice. This research result can help local universities' engineering majors better utilize the OBE education model, it has important guiding significance for the reform of experimental teaching.

Keywords: Water Treatment Experiment and Simulation Technology; Traditional Teaching; OBE Education Mode; Undergraduate Teaching

1. Introduction

Outcome-based Education (OBE) is an outcome-based education model, which focuses on the development of students, the learning outcomes of students, and the construction of the curriculum system in the way of reverse thinking, which is a new educational concept. For engineering majors, OBE education mode is particularly important, because engineering majors have a variety of employment directions, and the work has a strong experimental and practical, and the requirements for practical project experience are high. However, students trained under the traditional education mode cannot fully apply the theoretical knowledge they have learned to practice and work, and lack practical ability and innovation ability. As a result, the teaching effectiveness of schools is not ideal, leading to certain difficulties in students' career choices and work.

Water Treatment Experiment and Simulation Technology is a required professional basic practical course for students majoring in environmental engineering. This course mainly involves the theoretical study and practical operation of experiments and processes related to water treatment, and is one of the important courses to improve students' professional knowledge. However, in the teaching of this course under the traditional education mode, the emphasis is placed on the teaching of theoretical knowledge and the neglect of practical experiment teaching, which leads to the serious shortage of relevant professional practical knowledge of students. The OBE education model has the advantage of solving the contradiction between engineering students' inadequate professional skills and the

demand for professional talents in society. By comparing the traditional education model with the OBE education model in various aspects, the advantages of the OBE education model are highlighted, which is of great significance for future research on curriculum reform based on the OBE education model, and cultivating high-quality and practical talents with strong practical abilities.

2. The Deficiency of Traditional Education Mode in Experimental Teaching

2.1 Experimental Teaching is Not Valued

Experimental teaching is an important part of the teaching of science and engineering majors, which can not only improve students' theoretical knowledge level, but also lay a solid foundation for their practical work ability in the future[1]. There are many unreasonable points in the experimental teaching in most colleges and universities, because they value theory over practice. In terms of experimental teaching, some universities are unable to provide students with sufficient offline experimental operating conditions due to a lack of experimental equipment or insufficient funding, and adopt an attitude of not doing or doing less for most professional experiments. Moreover, experimental designs are mostly confirmatory experiments, lacking innovation and pertinence to professional knowledge [2]. As a result, students' practical ability and innovation ability can not be improved.

In the teaching arrangement of traditional education mode, less time is allocated to experiment, and there is a big gap between the time of students participating in experiment and the time of learning theory course. According to the survey, nearly 40 percent of undergraduates believe that the ratio of time between theoretical courses and experimental courses is inappropriate[3]. Because experimental teaching needs more manpower and material resources, most universities ignore it, and the class hours of theoretical courses are much higher than that of experiments. Students spend too much time and energy on theoretical learning, which not only hinders the development of students' practical ability, but also fails to effectively improve students' professional knowledge level. In addition, the traditional experimental teaching still adopts the traditional fixed

teaching mode of "preview - explanation - experiment - report", which is not conducive to cultivating students' interest in experiments, but also limits their thinking space, and affects the development of students' enthusiasm and innovation ability[4].

2.2 The Content of Experiment Teaching Lacks Pertinence

In the traditional education model, students' learning of professional courses is "many and miscellaneous", there are many types of professional courses, and the learning is not deep enough, and some professional courses are not relevant to the actual work of students in the future, resulting in students spending more energy on unnecessary learning. According to the survey, more than 60% of enterprises and employers believe that the theoretical knowledge learned by students does not fit the current social production practice. Employers do not approve the theoretical knowledge and practical ability of college graduates, the phenomenon of insufficient practice and theory among college students in higher education[3]. Due to the lack of pertinence of social work in the traditional teaching, the experimental teaching content also lacks pertinence. Most experiments designed for experimental courses in colleges and universities are mainly aimed at cultivating students' basic experimental hands-on ability and ensuring the integrity of course teaching, without considering the correlation between designed experiments and students' future practical work, and rarely involve experimental designs related to the most cutting-edge professional knowledge, which can not keep up with the development pace of this major[5].

2.3 The Structure of the Experiment Course is Unreasonable

The traditional education model is teacher-led, and the relevant teaching contents such as classroom teaching, homework, experiment design and examination form are all handled by teachers, and the teaching method is teacher-led. Teachers adopt the rigid method of knowledge teaching, which is difficult to effectively mobilize the enthusiasm of students. Students only passively accept knowledge, and rarely exert themselves to actively explore new learning content and new experimental design

in class. Students lack of interaction with teachers, low freedom of learning, low polarity of students to the classroom, dull classroom atmosphere, students lack of learning motivation[6]. It leads to low learning efficiency of students.

In addition, the traditional education model has a single assessment method, and the experimental teaching scoring method is mainly based on the content of the experiment report and attendance, which in turn makes the teaching into "exam-oriented education". Students do not study hard at ordinary times, and they will plagiarize and fabricate experimental data in the process of testing, and learn solely for the so-called high score, unable to learn real knowledge. This single assessment method will make students unable to concentrate on participating in experimental learning and lack self-initiative in learning[7]. It is unreasonable to judge students' mastery of professional knowledge only by the scores of exam papers or experiment reports.

2.4 There are Few Opportunities for On-Site Practical Learning

In the experimental teaching under the traditional education mode, there is almost no field practice, resulting in the disconnection between students' theoretical knowledge and practical work. Experimental teaching of "Water Treatment Experiment and Simulation Technology" in traditional education mode, students use traditional experiments to further learn the theoretical knowledge of the textbook, and have a preliminary recognition of the principles and processes of various water treatment experiments and water treatment processes, but this is far from enough. In the traditional education model, for large-scale professional knowledge such as sewage treatment plant technology in water treatment system or black and odorous water restoration project, students can only learn the principles through books and carry out simple experiments in the laboratory. There is no online virtual operation through simulation technology to further improve the learning of theoretical knowledge, and there is no field trip to learn the real operation and process flow of equipment such as sewage treatment plants. When students actually come into contact with some process equipment in the future work, they are still ignorant and unable to closely

combine theoretical knowledge with practice.

3. Characteristics of OBE Education Model in Experimental Teaching

3.1 Teaching is Results-Oriented

In the OBE education model, teachers aim at students to achieve learning outcomes[8]. First of all, the output goal of curriculum teaching is determined, and the learning outcome of students is taken as the ultimate goal of teaching. Focus on evaluating students' learning outcomes, and then reverse design the course teaching content on this basis, and the learning outcomes of each teaching content should have a strong correlation with students' future work.

For example, in the OBE education mode, in the experimental teaching of "Water Treatment Experiment and Simulation Technology", it is necessary to first determine what kind of learning results students need to obtain after learning the professional course. For example, students should be able to master the basic principles and debugging of AAO (Anaerobic-Anoxic-Oxic process) in practical work after learning this professional course. On the basis of this learning achievement, the teaching design of this professional course should involve the experiment and practice of AAO process. For example, the commissioning operation of AAO process is arranged in the virtual simulation experiment and the construction, operation and commissioning methods of AAO process are watched and learned on the site of a sewage treatment plant. Therefore, in the experimental teaching design, it is necessary to pay attention to what students can learn through the course, teachers need to carry out real-time adjustment and update for each knowledge point in the teaching content output target, and develop flexible teaching strategies to help students better adapt to their jobs in the future[9].

3.2 Teaching is Student-Led

In the OBE teaching mode, the teaching method is flexible. Teachers stimulate students' learning enthusiasm through teaching content, methods and methods, so that students can actively participate in teaching and enhance students' independent thinking. In terms of experimental teaching, teachers leave students time to think and ask questions in the process

of teaching theoretical knowledge, give students greater freedom in the process of experimental operation, allow students to design experiments independently, improve students' ability to analyze problems and innovate design, and have strong interaction with students. Break the teaching scheme design idea of "fixed, linear, closed"[10]. Teachers pay attention to cultivating students' self-thinking ability, encourage students to put forward critical opinions on authoritative theories, and encourage students to fully express themselves in teaching activities. Students change from passive learning to active learning [3], and give play to their creative thinking. The core of teaching is no longer the teacher, but the student.

3.3 Various Ways of Teaching Assessment

The assessment of students under the OBE education model is not only a final exam, but the establishment of a variety of evaluation mechanisms and periodic tests to evaluate every link and performance of students in the whole learning activity. For example, in the experimental teaching of Water Treatment Experiment and Simulation Technology, teachers comprehensively evaluate the learning situation of science from the perspectives of Classroom performance, practical situation, experimental situation, learning literacy[11]. The assessment of the course can be divided into two parts: process assessment and final examination. The contents of the process assessment are as follows: preview the experimental teaching content before class; Test the experimental knowledge in class; In the course of class, the class activity, discussion and question answering and students' questions were graded to different degrees; Experimental assessment can be scored on many aspects such as experimental design, experimental operation and experimental report[9]. A variety of assessment methods can not only make students seriously participate in every step of the teaching process, but also improve students' learning interest and learning rigor. Through a comprehensive and reasonable assessment system, we can better stimulate students' initiative and creativity[5], Improve the achievement of course objectives.

3.4 Pay Attention to Field Practice Teaching

In the OBE education model, the experimental practice teaching is realized through the field learning method synchronized with the course teaching content. For experimental teaching, students should not only learn theoretical knowledge in the classroom, practice in the laboratory and operate virtual experiments online through simulation technology, but also carry out practical activities related to professional knowledge. For example, in the course "Water Treatment Experiment and Simulation Technology", after learning the theoretical basis of water treatment technology in class, students will go to the sewage plant, water plant and black and odorous water body treatment site to visit and learn under the guidance of teachers, and carry out some field experiments where conditions allow, firmly combining theoretical knowledge with practical work. Deepen students' understanding of professional knowledge and enhance their adaptability to job.

4. Comparison between Traditional Education Model and OBE Model

There are significant differences between traditional education model and OBE education model in many aspects. The emphasis of traditional education model is that teachers are solely responsible for teaching activities, students are simply passive receivers of knowledge, and teaching activities are aimed at completing teaching tasks, while students' learning status and final learning results are not paid attention to. OBE education model is oriented towards students' learning outcomes, making students the core object of teaching activities, which can stimulate students' learning interest and pay more attention to students' development in the whole teaching process, and pay more attention to students' learning outcomes after the end of teaching activities. The difference between the two is shown in Table.1. The following is the comparison between the traditional education model and the OBE education model.

Table 1. The Characteristics of Traditional Education and OBE Education Model

	Traditional education model	OBE education model
Teaching objective	Based on teaching content	Based on student learning outcomes

Teaching content	Old, untargeted	Novel, in line with social needs
Teaching dominant object	Teachers as the core	Students as the core
Practice time	Less about on-campus and off-campus practices	More about on-campus and off-campus practices
Assessment method	The method is single and subjective	Various methods, objective and comprehensive
Assessment content	The content is single, not comprehensive	Rich content, wide range of examination

4.1 The Focus and Objectives of Teaching are Different

OBE education mode organizes teaching according to the needs of students and the final learning results in the teaching process, which is different from the traditional education mode of "content-based", but has achieved a fundamental change to "student-oriented"[12]. In the experimental teaching, the emphasis is placed on the final learning results of students, and the reverse design is carried out based on the reverse thinking of students' knowledge, ability and quality to achieve the expected results[13]. From focusing on what students learn to focusing on what students need, the design of experimental teaching focuses on finding what students ultimately need to experiment. Follow the principle of "students' achievement-based" to reverse the design of guiding experiment teaching, so as to achieve targeted, improve the level of students' relevant professional knowledge. Pay more attention to "learning outcomes" than "teaching content design", take the needs of the actual society as the ultimate goal of teaching, highlight the practicability of teaching, and cultivate real social application-oriented talents.

4.2 The Dominant Objects of Teaching are Different

Different from the traditional teaching model, the teacher is the center, the teacher dominates the design and evaluation of the whole teaching process, and the teacher determines the cultivation goal, teaching content and curriculum evaluation standards, while the student is the passive recipient of knowledge. The OBE education model believes that the

most important thing in the teaching process is to cultivate students' knowledge acquisition ability, practical ability and personal quality, and students are the core and dominant objects in the whole teaching process. In experimental teaching, students are encouraged to independently choose experimental projects, formulate experimental plans, design experimental parameters, and design innovative experiments using theoretical knowledge. It provides students with more time for independent thinking and space for independent exploration, focusing on the teaching method of "teacher guidance, cooperative learning and collaborative teaching"[13]. The task of teachers is to give appropriate help to students when they encounter problems that cannot be solved to assist them in completing the teaching content.

4.3 The Degree of Emphasis on Practice Varies

The traditional education model emphasizes students' learning of theoretical knowledge in school, emphasizing theory rather than practice. Due to the lack of professional practice, students cannot convert the theoretical knowledge they have learned into practical working knowledge. As a result, students feel at a loss in social work. For example, in the teaching of Water Treatment Experiment and Simulation Technology, although the combination of traditional experiment and simulation virtual experiment has made up for many deficiencies, the teaching location is still limited to schools and the Internet, and students' understanding of water treatment technology is still limited to textbooks, without opening up a real "off-campus classroom". The OBE education model focuses on practical teaching, emphasizes the combination of theoretical learning and social work, encourages students to participate in field learning, and achieves the three goals of "theoretical learning, equipment familiarity and practical application" around the three aspects of "experience, practice and application"[14]. Combine theoretical knowledge with practical work to cultivate practical talents needed by engineering specialty.

4.4 Teaching Assessment Methods are Different

In the traditional education model, the course assessment method is simple, and most of the assessment and evaluation are conducted at the end of the semester, and students' learning and mastering of knowledge can be directly judged according to the total assessment number[5]. Most of the experimental teaching assessment methods in this mode are based on the students' experimental reports as the final basis for grading, and the students are not monitored throughout the whole process[13]. Such a single and rigid assessment method can not fully reflect the learning situation of students, and it is easy to lead to the situation of "only score theory", resulting in poor teaching effect. OBE education model has a reasonable teaching assessment system and evaluates students according to various evaluation standards[12]. In the experimental teaching, multiple key points and different assessment points are set up, and comprehensive evaluation is carried out according to the scores of students at each assessment point, reflecting the differences among students, helping students find their strengths and weaknesses, and comprehensively evaluating the learning quality and effect of students from the beginning to the end of the course.

5. Conclusion

For engineering majors, after comparing and analyzing the differences between traditional and OBE education mode in experimental teaching, OBE education mode has obvious advantages in training applied talents compared with traditional education mode. OBE education model takes the needs of the social industry as the standard, takes learning outcomes as the orientation, carries out reverse design of teaching design in reverse thinking, and constantly feeds back students' learning situation through teaching evaluation to continuously improve teaching design. Compared with traditional education concepts, OBE education model has higher flexibility and pertinence, and can enhance students' initiative and enthusiasm in teaching. If it can be applied to experimental teaching and follow the "results-based" principle to improve the traditional experimental teaching method, it can make students better grasp the experimental skills, enhance their experimental operation ability, cultivate their ability to analyze and solve problems, and cultivate their

teamwork spirit. Help students better and faster meet the needs of the industry, and cultivate higher quality applied talents.

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