

Teaching Reform of Environmental Engineering Microbiology Based on OBE Concept in the Context of New Engineering Disciplines

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Abstract In response to meeting the needs of cultivating applied talents in the construction of new engineering disciplines, based on the concept of Outcome – Based Education (OBE), this study analyzes the problems existing in the teaching of the course Environmental Engineering Microbiology, and put forward some corresponding curriculum reform schemes. According to the target points of professional graduation requirements, the scheme proposes revising the syllabus of Environmental Engineering Microbiology, clarifying the curriculum objectives, updating the teaching content, and reforming the teaching methods. Through these measures, it is intended to achieve the unity of teachers' way of "teaching" and students' way of "learning", construct a new teaching mode, fully stimulate students' subjective initiative, and enhance students' innovative consciousness and practical ability. Besides, in this study, a "whole process-diversification" evaluation system is established to comprehensively evaluate students' performance in theoretical knowledge learning and practical application, comprehensively evaluate students' learning situation, and analyze the teaching effect in real time, so as to achieve continuous improvement, and ultimately achieve the goal of improving classroom quality.

Key words New engineering disciplines, Outcome-Based Education (OBE) concept, Environmental Engineering Microbiology

0 Introduction

In response to major national strategies such as "Internet + " and "Made in China 2025", the Ministry of Education has put forward the requirement of actively promoting the construction of new engineering disciplines to cultivate applied talents with high practical ability and innovative thinking^[1]. Outcome – Based Education (OBE) concept is a talent cultivation mode in line with the current background of new engineering disciplines, and it is student-centered, results-oriented, and evaluates and continuously improves the teaching effect, to ensure the continuous improvement of students' autonomous learning, ability to solve practical problems and professional accomplishment^[2–4]. With the rapid development of China's social economy and the increasingly prominent environmental pollution problems, the society has put forward higher requirements for the comprehensive quality of talents^[5].

Environmental Engineering Microbiology is a compulsory course for the students of environmental engineering and resource and environmental science. This course is based on the theory and technology of microbiology, including the basic knowledge of microbial morphology, structure, growth and reproduction, physiological metabolism, genetic variation, microbiological mechanism of biological treatment technology and its application in the treatment of sewage, waste gas and solid waste. It studies the relationship between microorganisms and environmental pollution control, and how to use microorganisms in the environment to degrade pollutants, so as to provide an effective theoretical basis, methods

and technologies for solving environmental pollution. The course is rich in knowledge and covers a wide range of areas, which plays a connecting role in the professional curriculum system, and is the basis for the study of follow-up courses such as Water Pollution Control Engineering, Air Pollution Control Engineering, Solid Waste Treatment and Disposal, and Resource Recycling Technology. In recent years, new technologies and methods of Environmental Engineering Microbiology have emerged, and research results have emerged in an endless stream, which have been promoted and applied in the field of environmental engineering and resource and environmental science. Therefore, it is very necessary to promote the teaching reform of the course according to the training objectives of applied talents.

1 Problems in the Teaching of Environmental Engineering Microbiology

1.1 The teaching content is lagging behind, and the theory is out of touch with practice The course content of Environmental Engineering Microbiology totals 40 class hours and is divided into 12 chapters. Because there are many knowledge points in the course, and the teaching content can not be updated in time to include the latest development of the subject, students' interest in learning is affected. In addition, teaching mainly focuses on imparting theoretical knowledge, ignoring the cultivation of practical application ability, which makes it difficult for students to put forward effective solutions when facing problems. Taking Chapter 7 "Soil Microbial Ecology" as an example, this chapter not only covers the theoretical knowledge of the types, quantity and distribution of soil microorganisms and soil pollution, but also is closely related to the practice of soil microbial remediation engineering (including bio-ventilation, bioreactor, prefabricated bed method, on-site treatment method, *etc.*). However, in the actual teach-

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ing, the combination of these theoretical knowledge with practical application cases is not close enough, which is not conducive to the improvement of students' practical ability.

1.2 The teaching method is single, and there is a certain disconnection between "teaching" and "learning"

The first part of the Environmental Engineering Microbiology course is "Microbiology Basis", which mainly includes basic theoretical knowledge, such as the characteristics and classification of viruses, bacteria, protozoa and metazoa, the nutrition, metabolism, growth and reproduction of microorganisms, and so on. The teaching method is mainly based on teachers' teaching, while students are in a passive state of accepting knowledge, which leads to a certain degree of disconnection between "teaching" and "learning". This single teaching method is difficult to stimulate students' interest in learning and autonomous learning ability, thus affecting the cultivation of students' professional skills and innovative ability.

1.3 The course assessment and evaluation system is not perfect

The current assessment and evaluation method of Environmental Engineering Microbiology includes 70% of the final examination paper score and 30% of the usual score (attendance, homework, classroom performance). The types of questions in the final exam include multiple choice questions, judgment questions, blank filling questions, noun explanations, short answer questions and discussion questions. Although there are many types of questions, most of them are the elaboration of concepts, principles and methods, lacking the evaluation of students' learning process. The final examination results account for a large proportion, focusing on the assessment of students' memory. Some students' mastery of knowledge depends on the surprise review before the examination, and their participation in classroom learning is low, so students can not combine theoretical knowledge with practical application well, which is not conducive to cultivating students' ability to analyze and solve problems, practice and innovative thinking. These indicate that the current curriculum assessment methods mainly focus on evaluating students' memory ability of theoretical knowledge, but fail to effectively measure students' ability to use theoretical knowledge to solve practical problems, thus failing to accurately evaluate students' learning effect.

2 Measures for teaching reform of new engineering disciplines Environmental Engineering Microbiology based on OBE concept

2.1 Improving the course objectives and optimizing the teaching content

In the context of new engineering discipline construction, it is recommended to revise the syllabus of Environmental Engineering Microbiology based on the concept of OBE, and the comprehensive development of students' basic knowledge, innovative practical ability and comprehensive quality should be emphasized, so as to improve the learning effect of students. According to the graduation requirements, the course objectives of "trinity" of knowledge, ability and accomplishment can be set as follows: (i) knowledge objectives: students can master the theo-

retical knowledge of microbial classification, morphological structure, nutritional metabolism, growth and reproduction, heredity and variation; (ii) ability objective: students can master the microbial principles in sewage, waste gas and solid waste treatment engineering, and comprehensively use the basic knowledge learned and references to analyze the problems in the design process of environmental pollution control technology and propose solutions; (iii) literacy objectives: students can understand the frontier trends and research hotspots in the field of Environmental Engineering Microbiology through online resources, have the ability of autonomous learning, and develop good professional literacy and sense of teamwork by working with group members to complete tasks.

It is suggested that the relevance and hierarchy of chapter content should be established, the logic and systematic features of knowledge points should be sorted out, and the key points of teaching content should be highlighted according to the teaching objectives set in the context of new engineering disciplines and the requirements of OBE concept for curriculum practicality and application, to optimize and adjust the teaching content of Environmental Engineering Microbiology.

(i) In view of the complicated course content and many knowledge points, the contents of different chapters should be reasonably connected together, the mind map of the course content should be established, and the key and difficult points should be highlighted so as to facilitate students' understanding of the overall knowledge. (ii) It is recommended to teach basic knowledge points in combination with practical research or application cases, so as to strengthen students' understanding of basic knowledge and the cultivation of application ability, combine the theoretical knowledge of the first part with solving practical environmental problems to stimulate students' interest in learning; integrate the knowledge of soil science, environmental science and other related disciplines into the teaching content to cultivate students' comprehensive thinking and interdisciplinary application ability. (iii) Students are required to consult literature, understand the latest research results and academic progress in the field of disciplines, and combine with solving practical environmental problems to improve their interest in learning and autonomous learning ability. (iv) It is suggested that the teaching content should be constantly updated, and the frontier knowledge of microbiology, engineering application cases and teachers' scientific research achievements should be introduced into the classroom teaching process.

2.2 Reforming the teaching mode and strengthening the combination of "teaching" and "learning"

In the process of teaching, it is recommended to introduce a variety of teaching methods: (i) transforming the traditional indoctrination teaching method, applying interactive teaching methods such as group reporting and case analysis to classroom teaching, and inspiring students' ability to think independently through questioning and discussion; (ii) using the flipped classroom teaching mode, students are required to learn online high-quality curriculum re-

sources before class. Teachers ask questions according to knowledge points in class, students discuss and analyze them, and then teachers evaluate them to mobilize students' learning initiative; (iii) it is recommended to apply intelligent classroom teaching mode^[6], grasp students' learning process from multiple dimensions (classroom performance, teamwork, interactive discussion, online testing), and improve the quality of classroom teaching.

2.3 Strengthening the process assessment and establishing a diversified evaluation system In the process of teaching, it is recommended to form a diversified and whole-process evaluation method. (i) Through questionnaires, classroom feedback, interviews and other means, teachers can understand students' suggestions on curriculum content, teaching methods and textbooks, and adjust the curriculum design in a timely manner. (ii) It is recommended to adjust the proportion of final examination results and attendance results to 60% and 40%, respectively. The final examination strengthens the assessment of students' ability to analyze and solve problems by designing innovative open questions, and assesses the whole learning process of students by means of comprehensive training (engineering case design), course examination (innovative open questions, basic theoretical knowledge, concepts, principles) and process assessment (online test, homework, group discussion)^[7-8]. According to the evaluation results, the course implementation process is adjusted and improved to improve the teaching quality and effect.

3 Conclusions

According to the requirements of new engineering disciplines construction for the cultivation of applied talents, based on the concept of OBE, we analyzed the problems and shortcomings in the process of Environmental Engineering Microbiology teaching. It is recommended to revise the syllabus according to the indicators of graduation requirements, set the teaching objectives of "trinity" of knowledge, ability and literacy, optimize and update the teaching content, and reform the teaching methods. In addition, it is recommended to establish the "whole process and diversified"

evaluation system, realize the transformation from teacher-led to student-centered teaching mode, promote the comprehensive development of students' learning theoretical knowledge, innovative practical ability and comprehensive quality, enhance their innovative consciousness and practical ability, and achieve the purpose of improving the quality and effect of course teaching.

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