

# Research on the Course Construction of Fermentation Engineering Experiment Based on "Engineering Education Mode"

**Jingjing Peng**

*School of Biology and Brewing Engineering, Taishan University, Tai'an, Shandong, China  
271828339@qq.com*

**Abstract:** *The research is based on the concept of "concept-design-implement-operate (CDIO)" engineering education. Reference Engineering Experiment passed the modular curriculum content, curriculum design is carried out with project-oriented modules of conception, design, realization and operation, and the connotation and characteristics of the curriculum are systematically analyzed. In-depth analysis of the problems existing in the current curriculum, combined with the requirements of the construction of application-oriented universities, the modular content system of Fermentation Engineering Experiment course is constructed.*

**Keywords:** *Concept; Fermentation engineering; Course; construct*

## 1. Introduction

*Fermentation Engineering Experiment* is one of the main courses of biotechnology specialty, and it is an important course to cultivate students' engineering design, engineering practice and innovative thinking. Practical curriculum reform still needs to be explored and improved continuously in terms of curriculum content setting and teaching methods and methods. However, through the practice of curriculum reform of *Fermentation Engineering Experiment* based on CDIO-OBE concept, it is found that the new teaching content setting and teaching mode practice can promote students' understanding of engineering projects, cultivate students' autonomous learning ability and ability to analyze and solve problems, so as to achieve the goal of cultivating compound applied talents.

## 2. Curriculum innovation based on CDIO-OBE education model

CDIO engineering education mode is an innovative mode of international higher engineering education, which takes the life cycle from product development to product operation as the carrier, and allows students to learn engineering education mode in the way of initiative, practice and organic connection between courses. Based on the means of "project education and learning", students can integrate the improvement of engineering basic knowledge, personal ability, teamwork ability and engineering system ability. CDIO pays attention to students' initiative in engineering learning and integrity in practice through the process of engineering education. At present, there are many curriculum reforms based on the CDIO concept, the core of which is to guide students to study actively and practically with practical projects as the carrier, and to closely combine the cultivation of knowledge, ability and quality, so as to integrate theory, practice and innovation. Through "learning by doing" and "project-driven" teaching methods, we can master professional knowledge and practical skills. CDIO teaching mode can cultivate students' innovative design ability and practical application ability in the process of practical teaching.

Compared with the traditional concept of higher education, the concept of OBE pays attention to students' learning goals and learning achievements. The engineering education based on OBE concept is conducive to cultivating students' knowledge, ability and quality that they need after entering the society in the future, and meets the target requirements of compound applied talents training.

Through the modular curriculum content design and implementation of related experimental projects, such as design, demonstration, implementation, result analysis and evaluation, and combining with the whole process of design presentation, project demonstration and summary reply, process evaluation and discussion, the teaching purpose is achieved. The engineering teaching form of

CDIO-OBE is particularly important for improving students' understanding of basic knowledge of professional knowledge and its comprehensive application in engineering projects, cultivating students' professionalism and teamwork spirit, and meeting the needs of talents in the field of biotechnology in the new era.

### **3. Curriculum design ideas of Fermentation Engineering Experiment based on CDIO concept**

*Fermentation Engineering Experiment* is a practical course in which professional courses are closely linked with industry fields after all basic courses of biotechnology major are taught. CDIO concept is a typical "learning by doing" that integrates the learning process into the whole process of goal realization<sup>7</sup>. Therefore, the design idea of *Fermentation Engineering Experiment* is to take the whole process of fermentation products as the learning environment, such as process design, equipment operation, product realization, quality evaluation, etc., and realize the course objectives through the four links of course conception, design, realization and operation.

Curriculum conception is a learning goal based on the analysis of students' learning needs, including learning ability, personal professional ability, professional ethics training, teamwork and innovation ability training. The course content is designed based on "project". First of all, students learn independently and evaluate the learning effect through the learning resources of the network platform. Combining the learning effect with the continuous improvement of teaching and evaluation methods, the design of teaching content can continuously meet the needs of teaching objectives. The realization of the course is achieved under the laboratory conditions through the improvement of teaching mode and evaluation methods such as "learning by doing", flipping the classroom, combining the whole process guidance and process evaluation, and introducing achievement reward mechanism. Project operation is carried out in the form of "team" (group). Learners and instructors have clear responsibilities. Instructors are required to be close to guidance and answer questions in real time, so that the project can be completed and the course objectives can be achieved.

### **4. Curriculum content design of Fermentation Engineering Experiment based on CDIO concept**

Taking the course construction of *Fermentation Engineering* as the carrier and the training goal of professional talents as the guide, the course content of *Fermentation Engineering Experiment* was set up. The way to complete the experiment is to take the project as the carrier, requiring students to complete the main links such as early self-study and related knowledge and skills assessment, grouping topics, literature review, scheme formulation and argumentation defense, project implementation and summary defense. Change the traditional teaching method based on actual demonstration and students' observation. The "flip classroom" teaching mode of "learning by doing" is adopted, with students as the main part and teachers as the auxiliary part, and one project runs through all learning contents, so as to cultivate students' ability to combine autonomous learning with practice, analyze problems and solve practical problems, and work together to complete tasks.

After the curriculum reform, the content of *Fermentation Engineering Experiment* is divided into three modules. First, students can learn independently through the network resources, and during this period, they can combine with the interactive discussion with the instructors. Only after they have passed the examination can they enter the project start-up stage. At the start-up stage of the project, students are required to group freely, and the division of jobs within the group is clear. At the same time, each group is required to have a team leader (general coordinator), a chief respondent (PPT production and respondent) and a reviewer (to evaluate and score other groups). The division of labor among the members of the group is carried out by rotation, so that students can experience the transformation of different roles and responsibilities in their study. Finally, for the project acceptance module, this part requires students to submit a box-shaped project report, and make a summary reply to the content of the project report.

### **5. Carry out the teaching mode reform of Fermentation Engineering Experiment course of "learning by doing"**

The teaching content is modularized, and each module puts forward different learning requirements and objectives. There is a gradual relationship between modules, that is, only after completing the previous module learning can we enter the next module learning. Each module realizes the "learning by

doing" teaching mode by determining the target task completion time node and irregular tutoring, so as to cultivate students' active learning ability. Teachers, as instructors, should combine the modules: learning objectives and requirements to conduct targeted counseling and answering questions, interact and guide students in real time in the whole process, or adopt the methods of asking questions, answering questions, summarizing questions, etc. at the right time, so that students can always keep active learning enthusiasm.

## 6. Establish an evaluation system of students' learning effect based on OBE

OBE is a result-oriented evaluation model of students' education effect. Establish an OBE-based evaluation system for students' learning effect, which runs through the whole course teaching process and is a learning effect evaluation method with the participation of teachers and students in the course group. The evaluation system includes automatic evaluation of online learning platform system, intra-group and inter-group mutual evaluation, self-evaluation, teacher evaluation, self-report quality and other online learning platform automatic evaluation, including online learning completion of fermentation operation video learning, experimental safety knowledge learning and learning test results of learning platform. Group evaluation includes project demonstration report, practical evaluation, reply PPT production quality, reply, goal realization degree, etc. Practical evaluation includes practical training participation degree, operational standardization, operational error rate, teamwork degree, etc. In addition, the innovation of evaluation system introduces reward scores, that is, in the process of project completion, students can get additional reward scores if they put forward some suggestions for the project that have certain improvement, practical operability and are conducive to the increase of product yield. To sum up, we have built a formative learning assessment and evaluation system based on the concept of OBE through the evaluation of process links.

## 7. Conclusions

Through the research on the construction of the curriculum system of *Fermentation Engineering Experiment*, the curriculum teaching of biotechnology specialty in colleges and universities has been improved. During the implementation of the teaching reform, teachers' theoretical and practical teaching ability and the ability to serve the local economy have been exercised, and a number of outstanding biotechnology professionals have been trained. The dual effects of theoretical and practical teaching of biotechnology specialty have been achieved, and the teaching reform has achieved outstanding results. At the same time, it pays attention to the curriculum content reform and teaching reform, and studies and analyzes the guiding ideology, reform objectives, organizational forms, teaching contents, evaluation and assessment system and many other aspects of the physical education theory course in colleges and universities, and puts forward targeted reform suggestions.

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