

# Curriculum Mode Design and Construction of Biochemical Separation Engineering Based on CDIO

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## ABSTRACT

The social demands for qualified biotechnology talents with research innovation as well as application innovation. One of the valid methods was to adopt international CDIO engineering teaching mode to improve the construction of biotechnology discipline. Some trials based on CDIO were introduced in teaching model of Biochemical Separation Engineering to synthesize different acknowledgement, enrich the instruction method and make the teaching professionalism. Based on the investigation, teaching objectives and the syllabus were modified, and a harmonious and relaxing teaching atmosphere was created to stimulate students' creative motivation and develop students' personalities. Also at the same time, teamwork projects in project designs were used to make the students study in an active, practicing and course connective mode. A new teaching model based on the "Ability-Quality-Knowledge" structure is established. It benefits the teaching and enhances students' comprehensive engineering abilities. Through this mode, we successfully reached the objectives of knowledge teaching, skill formation, creative talent fostering and healthy personality development.

## KEYWORDS

Biochemical Separation Engineering, CDIO, teaching model, curriculum construction

Biochemical Separation Engineering, a practicing course of biological engineering department, is the follow-up course of biochemistry, microbiology and fermentation engineering and plays a decisive role in the curriculum system. For a long period, the curriculum was instructed and demonstrated by the teacher and students listened and imitated. In order to improve the students' actual abilities of analyzing and solving problem, the content of the course and the teaching method were reformed based upon the CDIO mode and variety of teaching methods were used to stimulate creative thinking of the students (Svanström & Lozano-García 2008). According to the theory of knowledge in class and the characteristics of different biochemical products, students use the relevant knowledge of Biochemical Separation Engineering to design the reasonable separation, extraction and refining process line. And in accordance with the design, they carried it out by their own and finished the whole the process of "theory - design - product" (Bankel & Berggren, et al. 2003), making themselves to complete the process of knowledge acquisition, transformation and ascension.

The main teaching method was changed to a connection mode containing lectures, discussion classes, three-stage project and PPT report, aiming to improve students' comprehensive qualities. Using case heuristic and interactive teaching method, appropriate research time was arranged to train students to understand and solve problems. The three-stage project was performed in the way that the students designed and finished the project independently with the teachers guidance and evaluation. The project oriented to trained the student's comprehensive ability to analyze and solve problem and it deepen the understanding of the students and developed their ability to analyze and solve problems. The discussion of course content in the form of PPT speech and the design results and its

analysis of the three-stage project cultivated the students' ability of information processing and language expression(Faust & Paulson 1998). Students are grouped into teams to carry on the discussion and the project appraise the whole process,which cultivated their consciousness of team cooperation spirit. The new teaching process was shown in Figure 1.

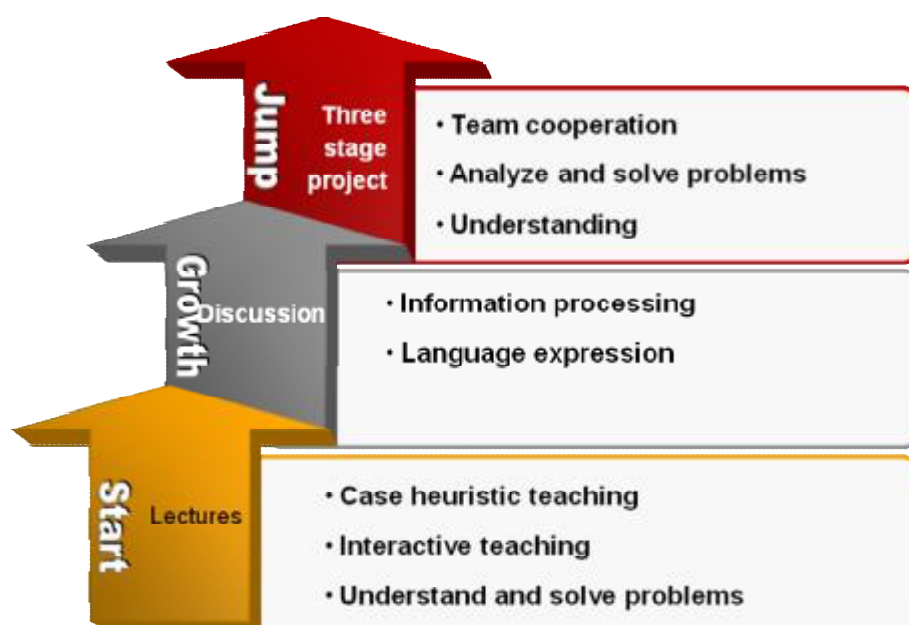


Figure 1 The new teaching process and curriculum construction of Biochemical Separation Engineering

At MIT, students declare their majors at the end of the first year, and typically begin study in their major at the beginning of the sophomore year(Hollister et al.,1995). The curriculum construction is similar with that mode in bioengineering department. The current students just finished completing the basic course and known little about the project when Biochemical Separation Engineering begin. So, how to choose the topic is the key problem. Three-stage project is distinct from experimental class and is around a familiar theme, which do not give too much pressure on students to produce awkward emotions. At the same time, various methods of extraction and separation would be familiar with as a whole. By screening, a total of five projects was selected, which could well cover basic biochemical separation techniques and gave the students ample room for their imagination and interest.

The specific implementation included the following steps. Firstly, specific learning task and problem to be solved should be cleared about before starting the class and the students should clear about the specific task to be completed and what knowledge should be acquainted after completing the task. Secondly, at the beginning of the course, existing knowledge and ability level of the students should be fully considered. Based on it, students were grouped in different teams. Each group chose a different topic and completed the theoretical idea and the actual process of the whole issue. Thirdly, students were asked to leave 1/4 blank in the respective notes, which should be filled by the concrete separation scheme of the three level project taken by themselves accompanied with the theory of each unit operation in the teaching process. After entering the specific operation module, the teacher checked part of the students after each class and guided them to realize the exchange of teachers and students and among students. Fourthly, through the implementation of the three-stage project,the students did the actual operation and completed different areas in a group. Also, they could achieve the integration of theory and practice and translated the process of knowledge constructing into problem-solving skills.And then, students demonstrated on the podium their own project results or solutions, analyzed the results, answered the questions, and accepted others' evaluation and teacher's feedback. In the process of reporting and listening to other students reporting, students could find the

deficiencies, and think about the success or failure and promote the knowledge structure by contrast. Throughout the course, the quality of students were improved from the knowledge, ability and emotional aspects. The Schematic diagram was shown in Figure 2.

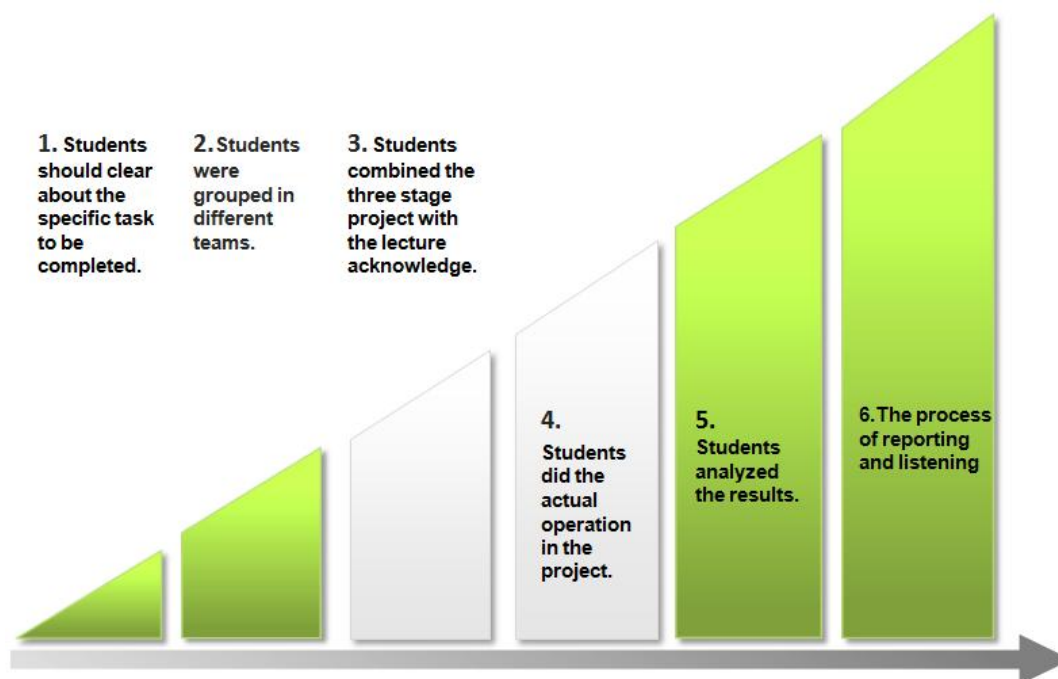


Figure 2 The specific implementation of curriculum mode of Biochemical Separation Engineering

The reform of performance appraisal was also very important. Evaluation and feedback was an important part of the process of teaching, a harvest during learning activities and a summary of the teaching process. Teachers should be fully affirmed the research achievement of the students in the evaluation process and timely give the students encouragement and praise, which could arise the students' enthusiasm and initiative. Students could be awarded after the discussion and the three-stage project. Evaluation of the process and results of the task included self rating and other rating, namely the self evaluation and the assessment on the standards of performance appraisal by the person in charge of production. To prevent some students from cheating, assessment must be for every student.

The survey showed (Figure 3), the new teaching method can promote the understanding of knowledge, ability and progress, improve the innovation ability and individuality. Teaching objectives and the syllabus were modified, and a harmonious and relaxing teaching atmosphere was created to stimulate students' creative motivation and develop students' personalities. Also at the same time, teamwork projects in project designs were used to make the students study in an active, practicing and course connective mode. A new teaching model based on the "Ability-Quality-Knowledge" structure is established. It benefits the teaching and enhances students' comprehensive engineering abilities. Through this mode, we successfully reached the objectives of knowledge teaching, skill formation, creative talent fostering and healthy personality development.

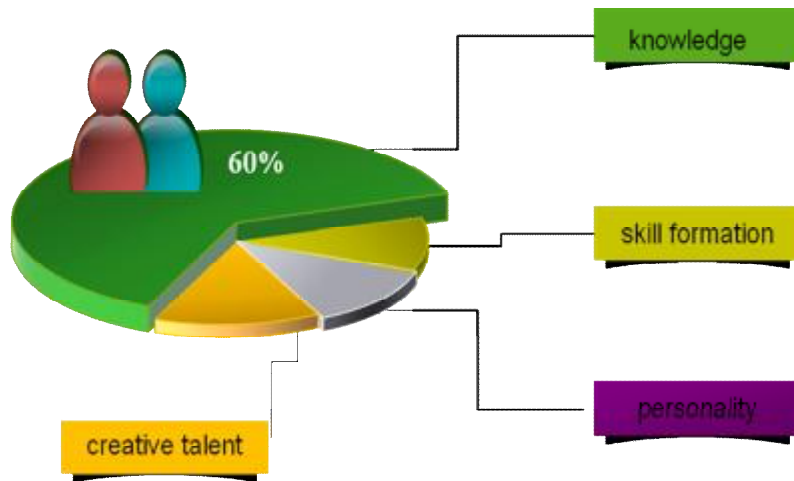


Figure 3 The results of the questionnaire on the students

According to the idea of CDIO, the biochemical separation engineering teaching content and teaching method were reformed which enhanced the students' learning ability and problem solving skills. The discussion course and practice course were added into theoretical classes so that the basic theory was in-depth during discussions and sublimated in practice.

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