

## Exploration and Practice on a Teaching Mode of Bio-Separation Engineering Course Based on Special Micro Classes

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**Abstract:** Nine special micro classes are designed and developed based on important special topics of bio-separation engineering course, and are composed of a serial, continuous, continuity and hierarchical micro classes. The extraction of C-phyocyanin (C-PC) using the ionic liquid-based aqueous two-phase system in special micro classes as an example, the teaching objective and methods, the record and script of micro classes, and interactive teaching of the research project were established. Additionally, the construction methods of the special micro classes and methods and means of auxiliary teaching were explored, and the reflection on teaching were carried out. The teaching method could provide the references for the improvement of the teaching quality of bio-separation engineering course in colleges and universities.

### 1. Introduction

In 2018, Ministry of Education of the People's Republic of China released the declaration of First-class Undergraduate Education in Chengdu. The declaration proposed the innovation and integration of the information technology under the background of internet and higher education, and courses were promoted the construction and applications of quality teaching resources. With the development of educational information, network, information and communication technologies have been deeply applied in the fields of education and teaching, which made the traditional classroom teaching face new challenges [1, 2]. Therefore, the search for effective ways of reform is the only way for the contemporary education.

At present, informative teaching modes such as flipped classrooms, micro classes [3], Khan Academy, massive open online courses (MOOC) and small private online courses (SPOCS) have set off a new wave of the educational reform, moreover, the integration of various teaching models provided a new and exploratory way for teaching reform [4-6]. Therefore, the formality of education information has made college teachers to master and use information technology to reform education and teaching models, promote the deep integration of information technology and higher education, innovate personal training models, and improve their abilities to use information technology to reform teaching models.

Bio-separation engineering is a core course for undergraduate students majoring in bioengineering in colleges and universities. This course covers the basic theory, method principles, basic equipment and typical applications of biological separation engineering. However, the teaching contents, abstract concepts and mechanisms are too many, the theoretical knowledge is difficult to understand and remember, and the theories and practices are difficult to achieve the masteries through a comprehensive study, which lead to realistic problems in the teaching content. With the rapid development of biomedicine industries, some new separation technologies have been playing an increasingly important role, resulting contradiction between the new knowledge and theory of separation engineering technology and the limited class hours becomes more and more prominent. Meanwhile, the core courses of bioengineering, such as enzyme and protein engineering, fermentation engineering and genetic engineering courses, have similar characteristics with bio-separation engineering courses. Therefore, under the premise of ensuring the existing teaching focus,

the integration of the latest research progress and applications with the course, the stimulation of students' interests in learning and the improvement of teaching quality have become a constantly explored subject for the teaching of engineering major. The main objective of this study is to design and develop special micro classes based on important special topics in bio-separation engineering course.

## 2. Production and Release of Special Micro Classes

### 2.1 Planning of Special Micro Classes

The special micro classes are designed and developed based on the difficult, important and hot topics of the bio-separation engineering course. And they are composed of a serial, continuous, continuity and hierarchical micro classes. According to the characteristics of the bio-separation engineering courses, the project team created nine special micro classes (Table 1), condensed the key teaching system of the course, and recorded related micro classes.

Table 1 Content of the Special Micro Classes in Bio-Separation Engineering Courses

Content	Title
Special micro classes No.1	Literature searching
Special micro classes No.2	Bioreactor
Special micro classes No.3	The safety use of centrifuges
Special micro classes No.4	The safety use of freeze dryer
Special micro classes No.5	Sea-water desalination technology
Special micro classes No.6	Hot issue of the marine drug
Special micro classes No.7	Ionic liquids two phase system
Special micro classes No.8	Chromatography
Special micro classes No.9	Electrophoresis

### 2.2 Design and Implementation of Special Micro Classes

Taking the extraction of C-phycocyanin (C-PC) using ionic liquids of one of the hot issues of bio-separation engineering courses as an example, a 5-6 min special micro class was made so that students could accurately understand and master the latest two-phase aqueous extraction system (Table 2). Based on the time axis, the script of the micro class combined with PPT, animation, pictures and so on to present a complete explanation system, and distributes the title, introduction, text explanation, summary, questions and ending to each time point.

Table 2 the Script of the Special Micro Classes Ionic Liquid Aqueous Two Phase.

Order	Content	Time (s)
Title	Special micro classes No.7.	8
Introduction	Introduction of C-PC extraction by ionic liquid aqueous two phase system, latest scientific achievements.	60
Text Interpretation	Introduction the concept of ionic liquid aqueous two phase system, its synthetic process and extraction principle, optimization during extracting, other potential applications.	240
Summary	Characteristics of ionic liquids two phase system.	30
Questions	Extraction mechanism of ionic liquids two phase system.	12

## 3. The Releases and Applications of Special Micro Classes

The special micro classes were generally in MP4 format, which was convenient for students to study on mobile terminals (QQ chat group). In order to improve the efficiency, effectiveness, and flexibility of the course, special micro classes could play a role in the three parts of the course before, during, and after the class (Figure 1). The special micro classes could optimize lesson preparation before class, let students preview before class, aroused students' thinking and guided students to prepare for class knowledge. Teachers could adjust the teaching according to the questions raised by students on the interactive platform during preview before class. Group

discussion, group report, and classroom communication were then conducted in the classroom to present a heuristic, interactive and discussion-based atmosphere between teaching and learning. After class, teachers communicated and answered questions with students through the interactive platform to complete the grade evaluation. Compared with previous years, students' average scores have also improved.

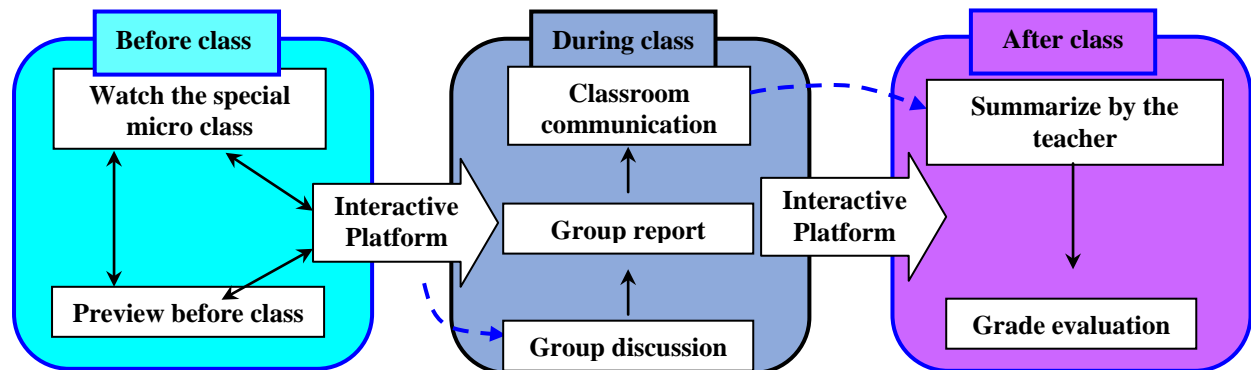


Fig.1 The Applications of Special Micro Classes on Teaching

#### 4. Reflections on the Application of Special Micro Classes

Through the practice, we thought that the special micro classes were also the base of the improvement of teachers' teaching and research ability, which was the most effective process of teaching and research among teachers. Due to the unique role of the special micro classes, we also realized that it would play an important role in the future construction of new quality courses and resource sharing courses. This project has carried out preliminary practice on the construction and application of micro classes, but there were still some problems, such as the unsatisfactory quality of micro classes, the function of micro class platform, the classroom instructional design based on micro classes and the evaluation system, which are all the directions of our efforts to improve in the future.

#### 5. Conclusion

At present, the integration of various teaching models has provided a new and exploratory way for the teaching reform of higher education. Among them, special micro classes that designed and developed based on some important topics have attracted so much attentions of teachers in colleges and universities. In this research, taking the extraction of C-PC using ionic liquid aqueous two phase in bio-separation engineering course as an example, special micro classes were recorded, edited and released. The construction methods and auxiliary teaching methods of special micro classes were also explored. The special micro classes could stimulate students' interests in learning and improve the teaching quality of engineering major in colleges and universities.

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