

Teaching Design and Exploration of Enzyme Engineering Course for the Medical College Majoring in Biotechnology

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Abstract: As one of the four major core engineering, Enzyme Engineering is a required course for students majoring in biotechnology and biological engineering. Enzyme engineering appeared originally in the food and light industry speciality of some engineering and agricultural colleges. However, with increasingly extensive application in bio-medicine, enzyme engineering was launched in various biotechnology and bioengineering majors in medical universities and colleges. Due to the differences in majors, enzyme engineering is set up in medical colleges with its own focus. Therefore, making the teaching of enzyme engineering meets the needs of the time, and cultivate qualified technical person engaged in the research and production of medical enzyme engineering, is an issue that professional teachers should confronted with.

Keywords: Enzyme Engineering course; Biotechnology; Medicine; Teaching practice

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Enzyme engineering is one of the core module of biotechnology major. It is not only the basic and important component of biotechnology, but also an important link in the industrialization of biotechnology. With the rapid development of enzymology research, especially the application and popularization of enzyme, enzymology and engineering permeate each other and develop into a new technological science, which is also an interdisciplinary subject produced by the combination of the basic principles of enzymology and microbiology and chemical engineering. It is a technique for studying and utilizing the specific catalytic function of enzymes and converting the analogous raw materials into useful substances through engineering. It is characterized by the use of enzymes or enzymatic organelles as biocatalysts to complete important chemical reactions. It is a technique for converting the raw materials into useful substances by using the catalytic properties of enzymes in a certain bioreactor and is an important part of bioengineering. Because of our students with medical science background, the course should be closely combined with the medical and pharmaceutical industries in order to highlight the thinking and specialty of biotechnology. Thus, making the teaching of enzyme engineering meets the needs of the time, and cultivating qualified technical person engaged in the research and production of medical enzyme engineering, is a question for professional teachers.

1. Explore reasonable education contents and system for medical college students majoring in biotechnology

Because it's originally from the food and light industry speciality of some engineering and agricultural colleges, the enzyme engineering course set should consider different background between different majors. Enzyme engineering is a highly specialized interdisciplinary subject. In order to take this course well, students are required to have basic theoretical knowledge of organic chemistry, biochemistry, microbiology, molecular biology, cell biology and biochemistry, etc. At the same time, there is also a certain requirement for the mathematical calculation ability of engineering. However, for medical college students, this aspect is their weakness, so the education system should adjust their requirements and focus on the content of this course. Guided by the idea of "adhering to the characteristics of engineering, strengthen the Neo-Confucianism construction", the course takes the unit operating principle and technological conditions of the main unit in the production and application of the enzyme as the core content. As a result

students can master the basic theory of enzyme production and application, and then guide the practice by theory, learn to analyze the technical problems in the process of production and application, and solve engineering problems. In order to stimulate students' desire, knowledge should not be restricted to the content of teaching materials. Besides, it is better to supply or delete the relevant content according to the requirements of the syllabus and the specific contents of the curriculum.

Since it is an interdisciplinary subject, the relationship between enzyme engineering and each basic course should be deliberated in the course arrangement. Thus, aside from absorbing new knowledge, students can review what they have learned, strengthen the understanding and realize that each course is interrelated, which can not be chosen arbitrarily on the basis of subjective wishes. It will bring great disadvantages to the systematic mastery of scientific knowledge. All in all, the study of science and technology must follow the scientific law.

2. Choose key points of teaching combining with the characteristics of speciality

The main content of enzyme engineering includes fermentation and production of enzymes, separation and purification of enzymes, molecular modification of enzymes, immobilization of enzymes and cells, kinetics of enzyme reactions, enzyme reactors and sensors, and application of enzymes, which are all centered around three problems: how to obtain enzymes, how to modify enzymes and how to apply enzymes. Although the main contents are similar, from the aspects of content and example selection, they usually take the students' perspective in engineering colleges because of its engineering origin. Then in choosing the teaching content, the teaching content and the teaching emphasis combined with the specialties' characteristics should be taken into consideration. As for the question that current teaching materials cannot meet the medical students' need, it is sensible to supply the relevant content to meet the teaching needs of students with different majors.

For example, the original course of enzyme engineering started from the food speciality and it mainly involves the development, transformation and application of enzymes in the food industry. With the continuous development of the biomedical industry, new technology and equipment have been applied to the development and utilization of enzymes, and the production, separation and purification of enzymes have been continuously improved, which has been able to meet the needs of the production and application of pharmaceutical enzymes. At present, enzyme is increasingly widely used in the field of biomedicine, from clinical diagnosis to treatment. Considering the selection of enzyme, emphasis should be placed on the application of enzymes in the field of medicine, such as the diagnosis of diseases with enzymes, the treatment of diseases with enzymes, the manufacture of various drugs with enzymes, and the use of enzymes as drugs for clinical treatment. The application of clinical knowledge and enzyme should be permeated with each other, which is helpful to the digestion and absorption of clinical knowledge.

In addition to the regular content, we should combine specialty characteristics of medical colleges and universities to supplement teaching content. The content (antibody enzyme, the molecular imprinting enzyme, heterozyme, enzyme molecular directed evolution, ribozyme and enzyme inhibitor, etc.) is only used as general elective and self-taught content in other engineering colleges and universities, and are not taught to students as emphasis. But in the medical university, these contents should be offered to students, especially antibody enzyme and enzyme inhibitor, which are essential for medicine and medicine specialty. Besides, they have provided great help to the development of medicine.

3. Apply various teaching methods for improving students' learning interests

In order to improve the enthusiasm of studying course, the teachers firstly should start from the introduction lesson, give full play to the introduction lesson to the whole course of guidance. In the course of the introduction, we use vivid examples to link enzyme engineering with medical biotechnology, which highlights the important position of the course in the subject. By introducing the relationship between enzyme engineering and other courses, including contents, development history and research progress, students can fully understand the significance of learning enzyme engineering. This will greatly help to stimulate students' interest in the follow-up course, thus increasing students' curiosity about the course and arousing students' enthusiasm to consult document after class. Teachers are also encouraged and motivated to actively prepare for follow-up course.

Comprehensive application of a variety of teaching means in the teaching process, can play an over effect. With the continuous development of network technology, it is more and more convenient for students to use the network to learn. The combination of online and offline teaching mode can be used to improve students' learning efficiency and interests. We have constructed multi-online teaching assistance platforms, including "AIKE", WeChat Official Account and "Yu Ketang", etc., and actively carry out blended teaching practice. Through the analysis of a series of teaching effect data, Teaching practice mode by using various forms of teaching resources and means reasonably and efficiently has effectively improved the classroom teaching effect, which will be summarized

in detailed in another paper.

The use of flipped classroom model can increase students' sense of participation and enhance the teaching effect. The teacher provided some course topics in advance, and the students prepared the lecture around the themes. For example, the production of enzyme separation and extraction can be prepared by the students themselves, and the teacher can give some supplements and summary, since the students have a certain understanding of the production of enzyme and mastered common methods and principles of separation and purification of some commonly used proteins at present. While summarizing the different methods of separation and purification delivered by the students, teachers should put forward the principle of choosing different methods of separation and purification depending on the requirements of the subsequent application of the obtained enzymes. Therefore, this mode of educating not only enables students to consolidate the knowledge, but also improves their ability to consult, summarize and verbally express their personal data. Meanwhile, it can stimulate students' interest through self-study.

In order to stimulate students' interest in learning, it is necessary to supply the important progress of modern enzyme engineering research both at home and abroad and to stimulate students' passion for scientific exploration. For example, in teaching the content, such as antibody enzymes, modification and directed evolution of enzyme molecules, ribozyme and enzyme inhibitors, and so on, the first introduction to students is the latest research in this field and published scientific research papers, then the knowledge. The enthusiasm of students is aroused from the innovation of teaching methods and knowledge content. Additionally, selecting some professional documents related to the curriculum and making an introduction, which make students learn how to search, read and write professional papers, and improve their professional ability. Out of class, we also encourage and guide the interested students to organize extracurricular interest groups to conduct in-depth discussion and research with teachers in their spare time, so as to exercise and cultivate their scientific research awareness and ability.

4. Improve practical ability by combining theory with practice

Enzyme engineering is an applied subject closely related to production practice. So examples of production and application of the enzyme in life should be introduced into classroom teaching to enrich students' perceptual understanding. Providing students with the idea of integrating theory with practice cannot only deepen their learning and understanding of theoretical knowledge, but also improve ability to find and solve problems.

At the same time, enzyme engineering is a subject with highly practicality and technicality, so the position of the experimental course in teaching is particularly important. Experimental teaching is the key of combining theory with practice, and it is an essential link in training professional technology of application and operating skill. In order to enhance the integrity, purpose and interest of the experimental teaching, the author combines the teacher's scientific research subject with the students' experimental course, and uses genetic engineering technology to produce human superoxide dismutase (SOD). This experiment contains a series of enzyme production techniques from upstream carrier construction to expression of superoxide dismutase and purification of products. The complete design of this experiment not only allows students to understand the production process of biotech production enzymes, but also can effectively stimulate students' enthusiasm for learning and interest in experiments. Through experiments, students' proficient ability can be really improved and practical profession can be cultivated.

Organizing enzymatic preparation factory visits depending on the actual course is a teaching method that combines the theory and the production practice, which makes students understand the real production process. In view of the production process, students can put forward problems and solve problems timely, which can deepen the understanding of theoretical knowledge and integrate theory with practice. In addition, providing that the conditions permit, students can also be arranged to visit the workshop during the practice stage, to understand the entire production process in detail, and to find out the technical problems that need to be solved urgently in the factory. Afterwards, the theoretical knowledge learned is really applied in production practice.

References:

- [1] Li Rong. Exploration on Blended Teaching Reform of Enzyme Engineering Under the Guidance of OBE Teaching Concept. Education and Teaching Forum, 2023,1(3):77-80
- [2] Li Jianrui, Wang Xiaoli, Zhao Runzhu, Research on Teaching Optimization of Enzyme Engineering under Hybrid Teaching Mode. Education and Teaching Forum, 2022,11(46):157-160