

Research on the Application of Internet-assisted Method in the Teaching of Fermentation Engineering Based on the Marine Characteristics

Huoxi Jin*

School of Food and Pharmacy,
Zhejiang Ocean University,
Zhoushan, China
jinhuxi@zjou.edu.cn

Xiaokun Ouyang

School of Food and Pharmacy,
Zhejiang Ocean University,
Zhoushan, China

Abstract—Fermentation engineering is a comprehensive discipline combining theory and practice. How to improve the teaching effect has always been a problem for teaching and research workers. With the development of the marine resources and "Internet+" in recent years, it is necessary to reform the traditional teaching models to adapt to the social development. In order to improve teaching efficiency and reflect the marine features of Zhejiang Ocean University, we made its first combination of marine knowledge with the Internet. The teaching content of "Fermentation Engineering" focused on marine micro-organisms and marine products. In addition, we made full use of mobile APP and WeChat platform to improve learning efficiency in the classroom. After one year of implementation, students' ability to master and apply the knowledge related to fermentation engineering has been significantly improved. Conclusively, this new teaching model significantly improved the quality of teaching.

Keywords—Marine; Teaching; Fermentation engineering; Internet-assisted

I. INTRODUCTION

China is a big maritime country with abundant marine resources. Marine medicine is an important choice for the continuous development of the biotechnology and pharmaceutical industries. Zhejiang Ocean University is located in the Zhoushan city, Zhejiang Province. It is surrounded by the sea and is the only public undergraduate institution named by the ocean in Zhejiang Province. On the basis of the unique advantages of rich marine resources, the university has established many sea-related majors, such as marine science, marine pharmacy, biotechnology, biopharmaceutical, and biological sciences. These majors are designed to provide talents of marine drug and marine life for China.

Fermentation engineering is techniques that produces useful biological products for humans or control the certain industrial processes using certain functions of organisms (primarily microorganisms) [1]. It is well known that the beer and bread are produced from yeast, the cheese and yogurt are produced from the fermentation of lactic acid bacteria, and the large-scale production of penicillin is produced by fung. With

the advancement of science and technology, fermentation technology has also been greatly developed that can artificially control and transform microorganisms to human products [2]. As an important part of modern biotechnology, fermentation engineering has great potential for future applications. For example, genetic engineering methods are used to modify existing strains purposely and increase the yield of products. Many microorganisms were cultivated to produce drugs such as human insulin, interferon, and growth hormone. "Fermentation Engineering" is the core curriculum of marine science, biotechnology, bioengineering and biopharmaceuticals. However, the prevailing problem is that the various knowledge involved in "Fermentation Engineering" was taught in accordance with traditional ideas. All knowledge of course was taught routinely without obvious focus and direction. We suggest that the syllabus and teaching plan for "Fermentation Engineering" should be formulated according to the characteristics of the school. For the majors of pharmacy, biotechnology and biopharmaceutical in marine universities, how to integrate the teaching of "Fermentation Engineering" with marine characteristics is a key issue [3].

Beginning with early computer-assisted instruction, we actively introduced the computers and products of information technology into the classroom. The computer multimedia assisted instruction system, including computers, projectors, large screens, sound amplification equipment, and central control systems, was firstly introduced into the classroom [4]. Due to these devices, it was convenient to bring together texts, audio, video, animation and other media, which provided great convenience for teaching. Therefore, the computer multimedia teaching system has been well accepted by teachers and students, and has been rapidly popularized and promoted [5].

However, most teachers emphasized the introduction of information technology and its products into the classroom, but preferred to exclude the Internet from the classroom. They excessively required students to master the complete subject knowledge system, but ignored the qualitative changes of the learning style in the Internet age. It is common that many computers in universities do not have Internet access. Smartphone has become an indispensable thing for almost every adult today. At present, most schools in China still do not

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allow the use of mobile phones in the classroom. The mobile Internet marked by smart phones is posing a serious challenge to classroom teaching.

We use the "Internet" and "teaching" as keywords to search on China Knowledge Network. The results were shown in Fig. 1 after statistical analysis. It was shown that the number of papers related to "Internet+" teaching reforms were dramatically increased in the past five years. The number of papers was only 131 in 2014, but increased to 623 in 2015. In 2016, this trend of increase is even more dramatic. Compared with that in 2015, the number of papers in 2016 had increased by 257%. Furthermore, there were an amazing number (3987) of papers with teaching reforms related to "Internet+" in 2018. The results indicated that the "Internet+" teaching subverts the traditional teaching mode, and is becoming a new trend in school curriculum and teaching reform [6].

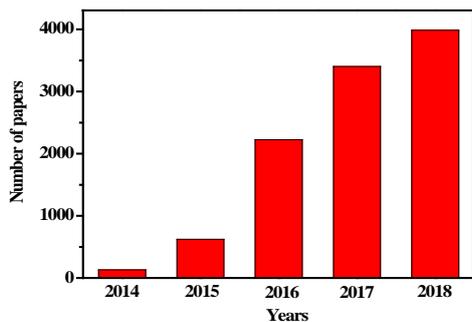


Fig. 1. The number of papers with teaching reforms related to "Internet+" in the past five years.

Subsequently, we searched and counted the number of papers with teaching reform related to the "Fermentation Engineering" course. It was shown from Fig. 2 that the increasing trend of the number of papers related to the "Fermentation Engineering" teaching reform year by year was not observed in the past five years. Furthermore, only one is related to the use of the "Internet+" in all these papers. This results suggested that the teaching model of "Internet+" has not been used in the teaching of "Fermentation Engineering" courses.

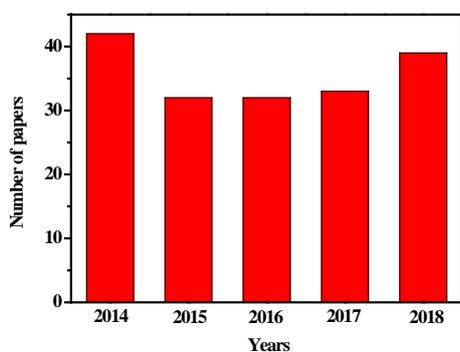


Fig. 2. The number of papers with teaching reforms of "Fermentation Engineering" in the past five years.

Therefore, this paper focused on exploring a series of teaching reforms in the course of "Fermentation Engineering" with the marine features. The teaching mode and method were reformed by introducing "Internet+" into classroom. Students brought their mobile phones into the classroom, then conducted check-in and discussions through the mobile APP. In addition, teachers can arrange assignments and answer questions remotely. Based on the marine environment, more perfect base of practice teaching can also be established

II. REFORM CONTENT AND METHOD

According to the development trend of the "Internet+" and the marine features in our school, we mainly performed reforms from the teaching content, teaching methods, and experimental teaching.

A. Reform of Teaching Content

According to the marine characteristics of Zhejiang Ocean University, the content of marine microbiology or preparation of marine drugs by fermentation was comprised in the "Fermentation Engineering" course, including the separation and purification of marine microorganisms, strain selection, the optimization of fermentation process, metabolite separation, and evaluation of bioactivity. For example, the depsipeptides with anti-tumor activity were prepared by marine microbial fermentation. In addition, we closely combined textbook knowledge with the frontiers of technology by using of internet in the teaching process. For example, in the section of preparation of starching hydrolyzed sugar, we used the relevant databases such as China Knowledge Network, SCI Database and Baidu Library to download the corresponding literature for comparing the methods with the textbook content. This greatly enriched the teaching content and encouraged students to master cutting-edge knowledge in a timely manner.

B. Reform of Teaching Methods

The traditional teaching mode was teacher-led, mainly as "teacher+student+classroom". This closed teaching method limited the initiative of students [7]. Therefore, we must make full use of multimedia and the Internet to explore new and advancing teaching methods. The traditional classroom teaching mode was improved by introduction of the flipping teaching. The classroom teaching and the self-study based on the online platform had been mutually integrated and complemented each other by use of the network teaching resources, such as micro-course, WeChat, and mobile APP. This teaching method can realize the multiple interactions between teaching and learning, so that the leading role of teachers and the key role of students can be effectively reflected.

1) Internet into the classroom

Students was encouraged to bring their own mobile phones and microcomputer in classroom. They were allowed to freely access the Internet in class for searching the relevant knowledge. Teachers also directly used the teaching resources on the Internet to improve the quality and efficiency of teaching. The assignments and examination were arranged by

the WeChat official account or the corresponding APP. Students shared their knowledge and skills, exchanged learning experiences, and conducted learning competitions through the Internet. In addition, the mobile phone can be used to take pictures or record a video of the important contents in the classroom, so that students can re-learn the knowledge anywhere and anytime.

2) *Life practice into the classroom*

The teaching content was no longer limited to the textbooks and outlines. The real cases from the network or life were taught and discussed in class. By combining teaching with life and research, teachers introduced students to what they have been studying recently, what articles they have written, what problems they have encountered and how to solve. Teachers demonstrated the processes and methods of their research, shared the experiences of their successes and failures. The teaching method with story-telling greatly aroused the students' interest, resulting in a good atmosphere for class. In addition, sharing the personal experience of teachers has a great inspiration for students' learning and life.

C. *Reform of Experimental Teaching*

The traditional experiment of the "Fermentation Engineering" was based on generalized experimental techniques, such as the Gram staining, morphological observation, and fermentation of *E. coli*. These experiments were too simple, and did not combine the characteristics of the school or the major, which is not beneficial to the students' divergent thinking. In addition, it was not conducive to the cultivation of the students' innovative ability. Therefore, we proposed a new way of experimental teaching. The experiment of the fermentation engineering was performed by combining the theoretical knowledge with specific research of teachers. This kind of experimental course not only enabled students to understand the cutting-edge research and master cutting-edge technologies, but also helped teachers to complete the corresponding research project. The design method of this kind of experiment was quite flexible, so that the same experiment was repeated by student every year could be avoided. This model of experiment greatly improved the abilities of students' thinking and innovation. For some latest, cutting-edge research methods that were difficult to implement in the lab, students could learn through video.

III. CONCLUSION

Fermentation engineering is a highly practical and developmental discipline. It is an integrator of modern biotechnology and widely used in food, medicine, and environmental fields. In recent years, on the one hand, with the emergence of the "Double First-Class" initiative, major universities have paid more and more attention to the

characteristics of the school, and strive to develop their own characteristics and advantages. On the other hand, under the conditions of network technology, like big data and cloud computing, the role of the Internet in education is more and more important. In the future, the Internet is a "teaching courseware", and the smartphones and computers are the "blackboards" for teaching. At present, there are five ocean universities in China. The development of the sea-related majors is the top priority of these schools. However, in undergraduate teaching, few teachers emphasize the teaching content on the marine fields. We firstly used the "Internet+" teaching model in the course of "Fermentation Engineering", and extended the teaching content to the fermentation of marine microorganisms and the preparation of marine active substances. We implemented the method in the 2015 and 2016 undergraduates of biopharmaceuticals. The results showed that the class atmosphere and teaching quality were significantly improved. The failure rate of students' final exams dropped from around 25% in 2013 and 2014 to less than 10%. The results showed that this teaching model had certain advantages and was worth promoting in other ocean university.

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