

Reform and practice of biochemistry experiment teaching under the background of industry-university-research integration

Congping Tan¹, Wu Meng^{2, *} and Feng Ding^{2, *}

¹College of Food Science and Engineering, Qilu University of Technology (Shandong Academy of Sciences), Jinan, China

²College of Biological Engineering, Qilu University of Technology (Shandong Academy of Sciences), Jinan, China

* Corresponding Author Email: Mengwu666@163.com; bio_ding@126.com

Abstract. Biochemistry experiment is a basic experiment course that transforms biochemistry knowledge into practical operation, which plays a vital role in training students' hands-on practice and scientific research accomplishment. In order to cultivate students' comprehensive ability (innovation ability, practical ability, problem analysis ability and problem-solving ability), and change the drawbacks of traditional teaching, we give full play to the role of industry-university-research integration in biochemistry experimental teaching. Relying on social resources and professional forces, the curriculum system is designed together, the curriculum experiment is modular, and a large experiment of subject inquiry is formed. Furthermore, the competition should be included in the biochemistry experiment teaching to stimulate students' interest in learning and cultivate students' comprehensive ability.

Keywords: Industry-university-research integration; Biochemistry experiment; Educational reform; Ability training.

1. Introduction

Biochemistry is a basic course for food and bioengineering majors. It is a subject driven by experiment, and its experimental ways have a profound impact on students' study of other courses. Biochemistry experiment enables students to practice the separation, analysis and identification of biological substances, get familiar with the research methods of substance metabolism, deepen the understanding of biochemistry knowledge, and improve the ability of students to discover, analyze and solve problems. Biochemistry experiment technology is an important basic technology in the research field of life science. It is a basic practical skill for students majoring in food and bioengineering. On the one hand, in the original biochemistry teaching process, the experiment part is composed of several independent small experiments, each experiment has a single content, and the main purpose is to learn a certain experimental method. Students follow the experimental instructions step by step and are always in a passive state. This model greatly limits the initiative and innovation of students to do experiments, and seriously ignores students' interest in scientific research and the cultivation of comprehensive ability. On the other hand, students have to learn a lot of courses during the undergraduate period, so the time and energy invested in learning are limited. Making students to master the experimental technology most closely related to food and bioengineering majors in limited class is our basic aim for the construction of biochemistry experimental courses.

Industry-university-research integration mainly refers to making full use of different teaching and research environments, resources and advantages in personnel training in universities, research institutes and enterprises. In economic construction, it promotes the transformation and industrialization of achievements, promotes advanced science and technology, and carries out higher education to improve the quality of personnel training. Combining the school education that focuses on imparting knowledge with the production and scientific research practice that directly acquires practical experience and practical ability can solve the problem of disconnection between college education and social needs. As a result, the human, material and financial resources of industry,

science and technology, education and other aspects can be comprehensively utilized to form a strong synergy, so that the industrialization construction can be transferred to the track of relying on scientific and technological progress and improving personnel training, so as to obtain the best overall benefits.

Qilu University of Technology (Shandong Academy of Sciences), as a new institution integrating science and education, not only has a complete talent training system, but also has a whole chain of scientific and technological innovation from front-end basic research, to generic key technology research, transformation of scientific and technological achievements, and then to scientific and technological innovation enterprise cluster. Qilu University of Technology is now fully equipped with applied research and achievement transformation capabilities and superior resources for higher education. Therefore, making good use of the teaching, research and production resources gathered by the integration of science and education is an excellent opportunity for the high-quality development in the future.

2. Reform and Practice of Biochemistry Experiment Teaching

In terms of class teaching, on the basis of existing experiments to verify theoretical knowledge, we reform the experimental teaching content, appropriately increase comprehensive experiments and design experiments, and deepen students' understanding of theoretical knowledge. The course is divided into four parts: biological matter separation experiment, biological matter quantitative experiment, biological matter metabolism experiment and comprehensive experiment. Based on the Wisdom Tree website, we recorded the experimental operation video for the experimental project, showing the operation process of the biochemistry experiment in the whole process, and interpreting the experimental difficulties and key details in depth. Thus, the observation and analysis of experimental phenomena can be demonstrated in all directions. Some practice questions are configured after each experiment, which is convenient for students to preview and review. Before the offline experiment, the students first learned with the help of online resources and initiated discussions online in the form of groups, which can make up for the deficiency that it is difficult for teachers to know each student's mastery of the experiment in offline teaching. In addition, in order to systematically develop the ideological and political curriculum, the module of the experimental project is divided into three parts: knowledge, ability and accomplishment objectives. For example, in the experiment of "Determination of Protein Content by Coomassie Brilliant Blue Staining", the knowledge goal is to "understand the method of protein determination and be familiar with the principle of Coomassie Brilliant Blue staining method to determine protein content". Meanwhile, the ability goal is "to master the method and precautions for the determination of protein content by Coomassie brilliant blue staining", and the literacy goal is "to cultivate students' rigorous and realistic scientific attitude, integrity, professionalism, etc."

Taking winemaking major as an example, under the industry-university-research integration, the teaching team including winemaking industry experts carried out work process analysis. Based on the knowledge and ability required by the work tasks of winemaking, as well as the national occupational standards related to winemaking, the teaching content is selected, the content unrelated to winemaking is abandoned, the content of material changes in winemaking is added, the teaching situation is designed, and the ability training project is constructed. In the experimental teaching mode, experimental modularity is adopted, and the application background is set according to the characteristics of different majors, so as to form a large experiment of subject type inquiry. For example, for the application background of brewing major: saccharification capacity and protein content are the most important factors affecting malted leach rate of malted barley. The level of maltosylation mainly depends on the activity of β -amylase, which depends on the thermal stability of β -amylase. To establish an experimental module on this topic, there are two experiments. Experiment 1: β -amylase acted with soluble starch to release the reduction of maltose residues to reduce 3, 5-dinitrosalicylic acid to 3-amino-5-nitrosalicylic acid. In a certain range, the ratio of reducing sugar

concentration to color depth can be determined by visible spectrophotometer. Within a certain range, the concentration of reducing sugar is proportional to the color, and the product content can be determined with a visible spectrophotometer. Using this experimental principle, let students refer to the basic experiment "Determination of reducing sugar by 3,5-dinitrosalicylic acid colorimetric method", and refer to the literature to design experiments to study the effect of inorganic ions on the thermal stability of β -amylase. Experiment 2: Different varieties of malting barley were selected to design experiments, and the contents of globulin, albumin, gluten and gliadin were detected by Coomassie brilliant blue staining during barley germination (Students choose one to do). Let the students design the scheme first, then the teacher will summarize and put forward suggestions, and form the final scheme after discussion. Teachers should encourage students to explore by themselves and teach the methods and experience of exploration, so that students feel that learning is like their own research, and can have a strong interest in learning.

For the students of food major, this paper proposes a subject-type exploratory experiment "determination of the main nutrients in flour", including several experimental modules for the content determination of protein, reducing sugar, total sugar and other substances. With the traditional beverage tea as the theme, an experimental interest group was set up, and two modules of tea chemical composition determination and enzyme activity analysis were set up to expand extracurricular experiments. The determination of tea chemical composition mainly selected several experiments, such as the determination of tea polyphenol content, the determination of total flavonoids, the determination of anthocyanin content, the determination of soluble sugar content, the determination of total free amino acid content, the determination of protein content, and the determination of vitamin C content. Analysis of enzyme activity in tea mainly selected the determination of polyphenol peroxidase activity, catalase activity, peroxidase activity, peroxidase activity, etc. The traditional experimental report simply lists the experimental contents. After the curriculum reform, every experiment is a topic study, and every experimental report is a small paper with materials, methods and results. In this way, it is conducive to the connection between undergraduate study and master's study. In terms of classroom time arrangement, we fully considered the characteristics of different experimental times due to the differences in theoretical basis, experimental operation skills and reaction speed among individual students, and arranged the experimental classes in the afternoon or in the evening. In terms of classroom management, the position of the experimental operating table of each group of students is fixed and affixed with name stickers, so that teachers can make targeted guidance according to students' classroom performance. Before the end of each experimental class, on the one hand, teachers can arrange students to summarize the gains and losses in the experimental process, timely pay attention to and solve students' doubts, and discuss in groups. On the other hand, we can jointly analyze the rationality of data results and the reasons for data differences between groups. Guide the students to strengthen the training of basic operation skills and develop a rigorous scientific attitude during the experiment. This allows students to strengthen the training of basic operation skills, and develop a rigorous scientific attitude in the experimental process.

Meantime, combined with the school's school-running characteristics of industry-university-research integration, students are guided to use biochemical means to carry out open experiments and participate in teachers' scientific research. In addition, let students prepare their own non-classroom experimental topics to apply for college students' innovation and entrepreneurship projects, so as to mobilize students' initiative and enthusiasm and stimulate their innovative thinking. "Research on comprehensive Utilization of Acetoin produced by pre-hydrolysate Fermentation of fast-growing Poplar" and "Optimization of Microbial composting formula of rice straw from saline-alkali Land and Preliminary Study on Improvement of Saline-alkali Land based on ammonium gluconate" were approved as national college students' innovation and entrepreneurship training project. In addition to experimental classroom teaching, we focus on cultivating college students' innovative consciousness, innovative spirit and practical ability. Based on the school (teaching) state key laboratory of bio-based material and green paper, microbial engineering key laboratory of China light industry and food fermentation engineering technology center of Shandong Province, China and

Germany beer technology center and other scientific research platform and Shandong Academy of Sciences Creatures (research institutes) biosensor key laboratory, biological manufacturing technology research and development platform, Marine function Scientific research platforms such as Food Processing Demonstration Engineering Technology Research Center and Key Laboratory of Drug Screening Technology, a three-in-one talent training model of "teaching-research-practice" has been set up. Moreover, we fully tap alumni and corporate resources, and conduct in-depth research on companies with cooperative relationships. According to the industrial development and the transformation and upgrading of enterprises, the experimental curriculum system is constructed scientifically, the opinions of enterprises are solicited, the curriculum syllabus is formulated jointly, and the reform of teaching content, teaching model and examination evaluation method is carried out jointly. In this way, school-enterprise cooperation and resource sharing can be realized, so that students will be more experienced when they graduate and enter the enterprise in the future.

We encourage students to participate in the college students in Shandong Province of biochemistry experiment skill and innovative entrepreneurship competition (formerly Shandong college biochemistry experiment skills contest) ", "Internet +" contest of college students' innovative undertaking ", "challenge cup" national university student extracurricular academic science and technology work competition, "challenge cup" Chinese college students business plan competition, etc. In the process of participating in the competition, students' organizational ability, planning ability, experimental ability, innovative thinking, problem analysis, problem solving and other abilities have been continuously improved. They have mastered the operation methods of some instruments and learned to analyze and process experimental data. In this way, the competitiveness of students in the process of applying for jobs in enterprises is improved, and applied talents suitable for enterprises are cultivated. Taking the "Shandong Biochemistry Experiment Skills and Innovation and Entrepreneurship Competition for College Students (formerly Shandong University Biochemistry Experiment Skills Competition)" as an example, the teachers widely mobilized students to participate in the internal group competition of the class. The degree of mastery and the ability to operate the experimental skills are tested by interviews and experimental operation methods. The best students will be selected to participate in provincial competitions according to their performance, and the students will be guided by professional teachers and trained intensively according to their professional experimental skills to assist them to complete the competitions successfully. Through this model, we greatly mobilize the enthusiasm and initiative of students to learn. For the innovation and entrepreneurship competition, we contact the instructors and teachers in charge of student competitions in our college to invite the teachers who have won the national and provincial competitions to give special reports to students and answer questions on the matters for attention in the competition. Before participating in the school competition, each team will take part in the advanced competition. Experienced teachers who have won many awards in previous years will act as judges to point out the shortcomings of each team and then improve them. We continue to explore the teaching of biochemistry experiment under the mode of combining competition and teaching, and the achievements of science and technology innovation competition continue to improve, and have won a number of awards. In the past four years, teachers' team have guided students to win a total of 16 national and provincial competition awards of "Challenge Cup" and "Internet +" (National level: 1 special prize, 1 gold medal, 1 first prize, 4 bronze medals and third prizes; provincial level: 1 special prize, 4 gold medals, 2 first prizes, 1 second prize, and 1 bronze medal). Among them, the project of "Dripping Blood to Know "Poison" - International Leading Comprehensive Screening Test Paper for Respiratory Pathogens" won the Gold Award of the 7th China International "Internet +" College Students Innovation and Entrepreneurship Competition. The project will not only help the epidemic, but also support the diagnosis and prevention of infectious diseases in the future. "Royal Jelly Acid - - the first international leader of biological fermentation" won the gold award of "Internet +" College Students' Innovation and Entrepreneurship Competition in Shandong Province.

3. Summary

In summary, in the reform of biochemistry experiment course, we pay attention to the construction of scientific research and teaching platform as a link, and integrate the implementation process of scientific research projects and talent training. Relying on social resources and professional forces to standardize the definition and operation of the curriculum system, improve the comprehensive integration of teaching, research and production. It provides more educational resources and platforms with strong practical effect for collaborative education.

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