

Exploration and Practice of a Five-in-One Education System of Theory, Experiment, Enterprise, Scientific Research and Competition in Food Technology

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Abstract: Food Technology is one of the core course in programmes of Food Science Engineering and Food Quality Security of colleges, and plays an important role in the food engineering specialist training. In the current context of engineering education, food engineering students should have strong analytical and problem-solving skills. They should also have knowledge of a range of sciences and their applications to food. Therefore, a systematic and efficient teaching system is necessary. The College of Food Science and Engineering, Lingnan Normal University, has reformed the education system of Food Technology after years of reflection, exploration and practice. Relying on the advantages of disciplines and industries, and using real projects and real product research and development in the food industry and scientific research as the carrier, real learning environment and platform has been constructed. A Five-in-One education system that including theory, experiment, enterprise tour, science research and competition has been created. The teaching system conformed to the “Greater Food” Approach, kept pace with the development of industry, substantially improved teaching effect and strengthened training quality of specialists in food majors. In this paper, the Five-in-One education system was elaborated in detail, in hope of providing a useful reference for the training of food engineering students in China.

Keywords: Food Technology, Teaching Effect, Exploration and Practice

1. Introduction

Food Technology is one of the compulsory courses in programmes of Food Science Engineering and Food Quality Security of colleges or universities. It is a branch of science that deals with the methods and techniques involved in food production of raw materials, semi-finished products and finished products. It explores the relationship between physical, chemical and biological changes in food production for control and optimization by linking the changes in production process and technical parameters. Therefore, Food Technology is an applied discipline that integrates theory and practice and is closely linked to production [1]. In the current context of engineering education, Food Technology is designed to support a number of critical indices required for graduation in our food

specialist training program, including good experimental design, operation and analysis skills, ability to understand, design and innovate workshop processes, and ability to apply theory to production and serve society, which plays an important role in our food engineering specialist training. Food Technology is also essential with respect to talents training in other colleges and universities, including cultivation of students’ engineering awareness, innovation awareness, practical operation skills and innovation ability in new product development [2, 3].

Under the background of “Greater Food” approach, after years of reflection, exploration and practice, a five-in-one education system of Food Technology has been formed. This five-in-one education system of theory, experiment, enterprise tour, science research and competition has achieved good teaching effect.

2. Reflection on Teaching of Food Technology

Food Technology is one of the compulsory courses in the two programmes of Food Science Engineering and Food Quality Security. In the program of Food Science Engineering, there are 112 credit hours of which 64 hours for theory and 48 hours for experiment. In the programme of Food Quality Security, there are 80 credit hours, of which 48 hours for theory and 32 hours for experiment. The courses are set in the first semester of the senior (third) year, using the textbook “Food Technology” (edited by Wang Zhijun). The lessons involve in processing techniques and technologies for agricultural products, horticultural products, livestock products and aquatic products. Currently, the course has a number of problems occurred in the actual teaching as follows:

2.1. The Course Is Highly Applied, But Some Students Lack the Ability to Link Theory with Practice

As an important part of the knowledge system of food science, Food Technology not only focuses on processing techniques and technologies of food products but also involve in analysis and investigation of control of technological conditions for processing agricultural products, horticultural products, livestock products and aquatic products, thus requiring students to identify the selection criteria of technological conditions and methods and to master technological theories and applications. However, some students lack the ability to link, combine and transform theory into practice, resulting in an inability to understand and improve on practice, which further inhibits their creativity. This is demonstrated in the discussion section of students’ experimental reports and poor performance in the essay-type questions in their exams. As a result, students’ potential for applicative thinking, creative thinking and problem solving needs to be stimulated, developed and improved.

2.2. Food Technology Updates Fast, But Experimental Facilities and Equipment Are Outdated

The rapid development of food processing industry and fast update of food technology set higher requirements for food specialist training in colleges and universities [4]. Because of heavy duties and limit hours in teaching Food Technology, coupled with obsolete teaching contents, outdated laboratory equipment in most colleges and universities, the lessons are centered on simple operations in the module of food production, such as homogenization, heat sterilization and squeezing, which hardly meet the requirements of modern food production in terms of design, development and quality standards, resulting in a gap between theoretical knowledge and social production.

2.3. Students Have Limit Engagement with Communication and Interaction in Classroom

Food Technology syllabus has a variety of contents and big workload in theory, and involves multiple fundamental

knowledge, including not only core courses of food chemistry, microbiology, biochemistry, chemical principles, food nutrition, food machinery and equipment and food plant design but also ever-changing food technology, which leads to intense learning in classroom [5]. If students fail to prepare lessons and review in time, they will not be able to master mass information in the limited academic hours, and they will not be able to take the initiative and participate in discussions. As a result, students with poor foundation will lose their motivation and initiative in learning.

Given all that, monotonous lessons and obsolete experiments cannot meet the requirements of specialist training in food engineering, and cannot deliver talents in engineering technology with solid foundation and creativity to diverse domains like production, management, scientific research and education. It is necessary to reform the education system of Food Technology and establish a more diverse teaching system to create eligible specialists [6].

3. Ideas and Objectives of an Innovative Five-in-One Education System of Food Technology

3.1. Establish a “Greater Food” Approach and a Learning Atmosphere of “Learning Policy, Understanding Policy and Using Policy”

Establishment of “Greater Food” approach has been incorporated into the No. 1 central document released in 2016 as an important element to promote structural reform on supply side of agriculture. At the Central Rural Work Conference in 2017, General Secretary Xi Jinping stated “Chinese people have more diversified needs for food, which requires us to change our conception and establish a big agricultural and food conception, to obtain calories and proteins from arable land, grassland, forest and sea and from plants, animals and microorganisms, and to develop food resources through multiple ways in all aspects” [7]. At China’s “two sessions” in 2022, General Secretary Xi Jinping once again stressed the importance of establishing “Greater Food” Approach. Centered on the “Greater Food” Approach, a series of new ideas, perspectives and assertions proposed by General Secretary Xi Jinping are in line with the megatrends in Chinese people’s food structure and consumption structure, and are the compass for the construction of China’s big food landscape and the fundamental guidance for the development of the food industry in the new era [8]. Therefore, in the course of teaching Food Technology, it is necessary to steer the strategic direction of the “Greater Food” approach and actively guide students to establish a “Greater Food” approach, take initiative to study and follow national policies, and determine their academic and professional development according to national policies. The teachers shall strengthen their teaching in practice and encourage students to go out of the classroom, out of the laboratory, into the field, into rural areas and into enterprises, which helps students to have an

in-depth understanding of the actual needs of the modern food industry, to discover their defects, and identify their goals and learning directions. The core of “Greater Food” approach lies in the response to the changes in Chinese people’s food consumption structure and ensures food security and balanced nutrients for Chinese people. In recent years, China’s food industry has been transforming into a health-oriented industry that its impetus not only lies in the “three reductions” policy of reducing sugar, salt and oil but also depends on the excavation of abundant local plant and animal resources in accordance with the objectives of “Greater Food” approach, using cutting edge technologies to develop and produce food with significant functions of protecting people’s health [9]. Therefore, in the course of teaching Food Technology, the teachers need to not only guide students to understand the development of China’s food industry but also strengthen the fundamental courses such as Food Nutrition, Functional Food Science and Food Security, and emphasize on the connection and systematization between courses, focus on students’ ability to use their knowledge to connect food engineering issues with social needs, and develop students’ ability to not only evaluate the impact of solutions to food engineering issues on society and people’s wellbeing but also determine their responsibilities [10]. They should encourage students to take initiative to learn and to use knowledge in practice, so that they will understand the “Greater Food” approach in terms of social development and policy orientation, review their responsibilities with a historical and developmental perspective, and determine development direction and fulfill life in the context of overall national development and agricultural and rural modernization.

3.2. Optimize Teaching Effect in Line with Industrial Development

The ever-changing food industry requires students to update their knowledge system and to learn how to apply permanent theoretical knowledge to ever-changing practice [11]. This requires pluralistic lessons that keep abreast of the time. On March 25, 2022, the Ten Measures to Accelerate the High-Quality Development of Premade Food in Guangdong (YFB [2022] No. 10) issued by the Guangdong Provincial People’s Government suggested to accelerate the construction of a pre-made food industry with national and even global influence, and promote the high-quality development of premade food industry in Guangdong. The publication stated that the specialist training for premade food industry will be incorporated in the project of “Cantonese Cuisine Chef”, and vocational colleges (including polytechnic colleges) and ordinary colleges and universities are encouraged to set relevant courses, promoting the construction of “industry-university-research” bases for premade food. Therefore, Food Technology syllabus should comply with the government policy in Guangdong, guide students to understand and excavate market applications, thus being able to integrate multiple disciplines, rely on the “Cantonese Cuisine Chef” base, and exert advantage of colleges and universities in western Guangdong to purposefully setup

lessons of theory and practice related to premade food technology, such as processing and storage techniques for raw materials, semi-finished and finished products. Students are required to have in-depth knowledge in specific technology and understand relevant theories for quality mechanism and quality control, at the same time, they are guided to learn courses in nutritional science, functional food science and flavor science to develop a systematic thinking for new forms and categories of premade food, functional premade food (medicinal food), and selection and cultivation of raw materials. Standardization is one of the challenges faced in the industrialization of premade food products, that is, continuous control of quality and flavor. Since food security standards, raw material standards, processing technology protocols and product criteria (including physical and chemical indices, organoleptic qualities, microbiological indices, etc.) all need to be established based on good and stable processes [12]. In the evaluation of teaching effect, students are required to understand technological and non-technological requirements of workshop design for food production and have good insights on methods of plant site selection, production planning and workshop layout; they should be able to design modular components such as drying equipment, workshop and processes that meet the requirements of food engineering, presenting a sense of innovation and taking account of social, health, security, legal, cultural and environmental factors; they should be able to acquire knowledge in methods and principles of experiments related to food science and engineering and have strong hands-on skills.

4. Practice of Five-in-One Education System in Food Technology

4.1. Consolidate Theoretical Foundation in Multiple Ways and Integrate OBE Concept for Engineering Education into the Course of Teaching

The concept of outcome-based education (OBE) is one of the three conceptions recognized by China in engineering education, and is an idea guiding the construction of China’s engineering specialists [13]. OBE is used to organize, implement and evaluate teaching effect based on the expected learning outcomes. It is a student-centered teaching mode that fully stimulates students’ interests in the course [14]. Food Technology is a core course in the programmes of Food Science Engineering and Food Quality Security. In order to strengthen students’ theoretical foundation and extend the course content, based on the modules of industry needs, cutting edge technology, engineering cases and ideological and political elements, there are 64 credit hours in theoretical lessons, including processing and storage principles, livestock products, agricultural products, horticultural products, condiments, soft drinks and wine brewing processes. Experienced teachers are designated to teach the lessons, and experienced executives from enterprises are invited to give thematic lectures to strengthen students’ theoretical foundation. The teaching is outcome-based, student-centered

for continuous improvement in accordance with the requirements of engineering education. At the same time, the teaching will excavate ideological and political elements and incorporate these into lessons to fulfill the fundamental task of creating specialists with ability and integrity, enabling students to appreciate traditional Chinese food culture and ensure food security, further enhance their patriotism and cultural pride, and stimulate students' creativity, calling for the great rejuvenation of the nation.

4.2. Optimize Experimental Contents and Strengthen Practical Effects

Practical teaching is an indispensable part of specialist training system and of significance in developing engineering views and professional identity [15]. In the 2017 Notice of Higher Education Division on the Research and Practice of "New Engineering" issued by the Ministry of Education, it set clear requirements for colleges and universities with engineering majors to create application-oriented specialists with innovative ability in engineering [16]. As an important part of Food Technology, after years of exploration in experimental teaching, Food Technology Experiment has established a sounding practical teaching system of engineering innovation and added practical training contents such as engineering innovation, discipline competition and entrepreneurship competition, which have been included in the credit system. This facilitates to teaching theoretical knowledge and cultivating students' practical ability, innovation ability, collaboration ability and analytical ability. Our Food Technology Experiment is divided into three layers.

The first layer is experiments auxiliary to theoretical lessons, with 48 credit hours, including modules of meat processing, soy food processing, grain processing, fruit and vegetable processing, dairy product processing and wine brewing. The second layer is innovative experiments, including development of functional baked food, processing of subtropical fruits and vegetables, and development of new type of meal replacements. The third layer is open experiments, where students design and study food processing. These comprehensive practical trainings with multi-dimensional experiments have enhanced experimental teaching effect and strengthened students' innovative ability.

4.3. Combine Theoretical Teaching and Enterprise Tour to Enhance Teaching Effect

Food Technology is a practice discipline. Students are required to understand fundamental theoretical knowledge from theoretical lessons, and further strengthen their knowledge through experiments and enterprise tour, integrating theory with practice, so that they will improve their professional perception and learning effect [17]. At the end of Food Technology, students are arranged to visit representative enterprises in the industry, focusing on processing of carbonated beverages, dairy products, meat products, beer, frozen aquatic products and subtropical fruits. The contents of enterprise tour are listed in Table 1.

Enterprise tour helps students to integrate theory with practice, strengthen their theoretical learning and stimulate their motivation to develop a sense of professional responsibility and public mission.

Table 1. Contents of enterprise tour.

Company name	Content of study
Zhanjiang Swire Coca-Cola Ltd.	Coca-Cola processing principles and production technology
Guangdong Gemflavor Foods Co., Ltd.	Processing of Cantonese bacon and sausages; processing of Cantonese mooncakes
Zhanjiang Yantang Milk Industry Co., Ltd.	Production technology for sterilized milk and fermented milk products
Zhujiang Beer Co., Ltd.	Brewing principles and production technology for beer
Zhanjiang Guolian Aquatic Products Co., Ltd.	Processing of frozen aquatic products
Guangdong Hongbao Aquatic Product Development Co., Ltd.	Processing of frozen premade shrimp products
Guangdong Chubang Foods Ltd.	Processing technology of condiments

4.4. Cultivate Students' Innovative Ability for Food Processing Through Research Projects and Scientific Research Platforms

Ours school has two provincial research platforms, namely Guangdong (Western Guangdong) Characterized Biological Products Engineering Technology Research Center and Guangdong Moringa Resources Development and Utilization Engineering Technology Research Center, as well as Zhangjiang Premade Food Cooking and Nutrition Engineering Research Center, and has sounding research and training facilities. In recent years, the teachers in the course have hosted more than 30 projects at various levels, in which senior undergraduate students were encouraged and guided to engage with systematic trainings for research and innovation. The teachers' research projects include

laboratory research projects and university-enterprise cooperation projects. The former includes extraction and functional study of active ingredients from *Moringa oleifera* leaves, refining technology of functional ingredients in coffee grounds, creation of new processing technology for chitin, study of tea beverages and their functions, preparation of cellulose composites from pineapple peels, construction of soybean peptide/isoflavone composites, separation of resveratrol from dragon fruits and inhibition of bacteria, etc. The university-enterprise cooperation projects include development and processing of Moringa food, development of new rice cakes, development of new minced shrimps, development of frozen dumpling skins, development of new flaxseed oil, and development of frozen subtropical fruits, etc.

In addition, the school encourages students to apply for university-level, provincial and national innovation and

entrepreneurship training projects for college and university students, as well as projects such as “Climbing Program” in Guangdong. Under the guidance of their teachers, students can complete projects independently (as shown in Table 2). By participating teachers’ research

projects or hosting their own projects, students have developed specialist abilities and innovative thinking and skills, appreciated the value and power of knowledge, and understood that professional knowledge provide solutions for problems of enterprises.

Table 2. Food technology projects in which students have participated from 2021 to 2022.

Project name	Project level
Beer brew-fresh fruit fermentation technology	National Innovation and Entrepreneurship Training Project for College and University Students (2022)
Nourishing stomach – new resource food innovators of villous amomum	National Innovation and Entrepreneurship Training Project for College and University Students; General project of “Climbing Program” in Guangdong (2022)
Physical field induced soy peptide-dextran-isoflavone interaction to construct responsive structured grease materials	General project of “Climbing Program” in Guangdong (2021)

4.5. Create a Good Academic Atmosphere and Improve Students’ Special Skills Through Various Competitions

Competitions include Challenge Cup, Internet+ and special competitions. Participation in competitions is also an important approach to improve students’ innovation and entrepreneurship abilities in specialist training. Competitions in which Food Technology majors have participated in recent years are listed in Table 3. Projects in competitions demonstrate the special skills in Food Technology and reflect the strengths of Food Technology, such as “Nourishing stomach – new resource food innovators of villous amomum”, “Beer brew – fresh fruit fermentation technology”, “Physical field induced soy peptide-dextran-isoflavone interaction to construct responsive structured grease materials”, “Sunpa Health Food Technology Co.”, “Fei Yong villous amomum

sugar-free chewing gum”, and “Preparation of soy protein-based multi-phase composite granular-stable Pickering emulsion”, etc. In 2021, Yiren - healthy functional chewing gum” won the silver prize in the 7th China International “Internet+” College and University Students Innovation and Entrepreneurship Competition. The team registered Zhanjiang Yiren Food Co. and applied for trademark and business licence. In addition, the school has been supporting students to grouping and participate in Food Industry Engineering Practice Training Comprehensive Ability Competition and win awards every year. Through pre-competition propaganda, in-competition guidance, post-competition summary and experience exchange, the school has created a good environment and atmosphere for competition, and improved students’ comprehensive special knowledge, abilities and skills.

Table 3. Students’ specialist competition awards.

Name of achievement (project)	Prize (Qty.)	Awarded by
The 8 th China International “Internet+” College and University Students Innovation and Entrepreneurship Competition (2022)	Silver (1) Bronze (1)	Department of Education of Guangdong
The Fourth National Food Engineering Practice Training Comprehensive Ability Competition (2022)	Second Prize	Jiangnan University
The 7 th China International “Internet+” College and University Students Innovation and Entrepreneurship Competition (2021)	Gold (1) Silver (1) Bronze (2)	Department of Education of Guangdong
The Third National Food Engineering Practice Training Comprehensive Ability Competition (2021)	Second Prize	Jiangnan University
National E-Commerce “Innovation, Creativity and Entrepreneurship” Competition Guangdong Competition (2021)	First Prize (2)	Committee of National E-Commerce “Innovation, Creativity and Entrepreneurship” Competition
School’s Internet+ Innovation and Entrepreneurship Competition (2019)	Third Prize	Lingnan Normal University
The First National College and University Students Food Engineering Virtual Simulation Competition Finals (2018)	Third Prize	Jiangnan University
Challenge Cup” National College and University Students Innovation and Entrepreneurship Competition (2016)	Silver	Central Committee of the Communist Youth League

5. Conclusion

Food Technology plays an important role in training specialists for food engineering and technology, and is an important course to deliver talents in domains of production, development and quality control in food industry. In the context of engineering accreditation and ideological and political education, the five-in-one education system of theory, experiment, enterprise tour,

scientific research and competition in Food Technology has been created. It has substantially improved teaching effect and strengthened training quality of specialists in food majors. Therefore, the education system is worthy of being extensively applied. It can effectively make up for the shortage of practical ability education in some science and engineering colleges and universities. In the follow-up study, we can explore how to strengthen the practical skills of teachers, so as to improve the teaching effect of theoretical lessons.

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