International Journal of Education and Humanities
ISSN: 2770-6702 | Vol. 24, No. 2, 2026

Integration and Reform of Modern Food Testing Technology Curriculum under the Background of "High order, Innovative, and Challenging"

Yishan Fang*, Ziteng Wang, Congping Tan, Shaoze Huang, Haifeng Yu, Bo Cui*

College of Food Science and Engineering, State Key Laboratory of Biobased Material and Green Papermaking, Qilu University of Technology, Shandong Academy of Sciences, Jinan 250353, China

* **Corresponding author:** Yishan Fang (Email: fangysh123@qlu.edu.cn); Bo Cui (Email: cuibopaper@163.com)

Abstract: Modern food testing technology is a course that requires a complete theoretical knowledge system, integrating more practical content and interdisciplinary knowledge to stimulate students' innovative practical ability and active exploration spirit. According to the standard under the Golden Course Construction Standards, we integrate "High order, innovative, and challenging" into the course construction, improve the teaching quality and level of modern food testing technology courses, and strive to cultivate outstanding talents with profound professional knowledge for society. In the curriculum reform, comprehensive and in-depth improvements are made from updating teaching modes, reforming classroom methods, expanding interdisciplinary knowledge, and improving assessment methods. By combining multiple educational methods, the integration of the concept of "High order, innovative, and challenging" is achieved.

Keywords: High Order, Innovative, and Challenging, Modern Food Testing Technology, Multidimensional Development, Diversity Assessment.

1. Introduction

To this day, the issue of food quality and safety has been a hot issue of concern to society as a whole, and strengthening food safety testing is an important means to ensure food safety. As a core course in food quality and safety, food science and engineering, modern food testing technology courses require complete theoretical knowledge based on a combination of chemistry, physics, mathematics, biochemistry, computer science, and other disciplines. Meanwhile, the practicality of the course is particularly noteworthy, as students are required to synchronize with the practical activities of food testing technology to ensure that they carry out scientific and accurate testing work[1,2]. In October 2019, the Ministry of Education in China further released the "Implementation Opinions on the Construction of First-class Undergraduate Courses", which puts forward that the construction of the courses should adhere to the classification of the construction and support for special features and strengths, and enhance the higher-order nature, highlight the innovative nature, and increase the challenge degree, referred to as the "High order, innovative, and challenging"[3].

Industrial development, Education first. The Ministry of Education held a seminar on the construction of new engineering disciplines, which put forward that by 2030 a world-class engineering education system with Chinese characteristics should be formed; and by 2050, it should be built into a powerhouse of engineering education, leading the global engineering education. Therefore, the modern food testing technology course should be oriented to "High order, innovative, and challenging", vigorously promote the construction of the course, make it a characteristic course of the school, and continue to explore the field of food testing technology, to send and train more excellent talents for the country.

2. Concept and Importance of "Advanced, Innovative, and Challenging"

The concept of "high order, innovative, and challenging", i.e. high order, innovation, and challenge, is the construction standard of the first-class course, i.e. gold course, put forward by the Ministry of Education[4].

The so-called higher order is the organic combination of knowledge, ability, and quality, which aims to cultivate students' comprehensive ability to solve complex problems, realize the cultivation of advanced thinking, rather than simply learning general knowledge, and strive to improve students' ability to deal with complex problems in real life[5]. Innovativeness means that the course content needs to reflect the cutting edge of the times, to achieve timely updating of the course content by the progress and development of the times, and the teaching form should present advanced and interactive features different from the traditional ones, so that students can experience the fun of the course and learn more new knowledge for independent exploration in the process of attending the classes, thus making their final learning outcomes personalized and uniquely exploratory. The so-called challenge degree means that the course has a certain degree of difficulty, not in the traditional sense of the pursuit of "get by", to stimulate the students' desire for in-depth exploration, the need for students to take the initiative to learn, and enhance the learning intensity to achieve complete mastery of the course.

From the standard of "High order, innovative, and challenging", we can conclude that this concept puts forward a new development goal for the teaching of higher education in China[6], China's higher education has been different from the traditional teaching concept and entered a new era of high-quality development.

3. Current Teaching Status of Modern Food Testing Technology Course

With the increasing attention to food safety issues and the continuous emergence of advanced technologies related to food testing, curriculum teaching should keep pace with the times, as to avoid the aging of the old teaching content to affect the learning effect of students, as well as the complexity of the system knowledge to combat the motivation of students to learn. We are constantly integrating the content so that it remains systematic and can be combined with the "High-order, innovative, and challenging " teaching concept.

Compared with the concept of “High order, innovative, and challenging”, the teaching of modern food testing technology programs still has difficult problems that need to be reformed. Therefore, it is necessary to eliminate the traditional backward learning materials on time, introduce new ideas and new technologies, and introduce the latest scientific research results in the industry. Only in this way can the system be continuously optimized and upgraded to build a first-class course with high order, innovation, and challenge, to attract students' interest in theoretical learning and practical activities, create and use learning materials with practical value, and improve the educational impact of the course. In the design of the course content, the focus of theoretical knowledge explanation is combined with the key contents of practical experimental activities to lay the foundation for improving students' practical hands-on ability[7].

4. Curriculum Construction of Modern Food Testing Technology

Combined with the background of the creation of “first-class universities”, and with the guiding principle of “High order, innovative, and challenging”, we will improve the teaching of the modern food testing technology course, and provide a set of modern food testing technology courses with the main purpose of cultivating more talents. The main purpose of the program is to cultivate more talents. The modern food testing technology program is aimed at the quality of education, ensuring that food students have high quality and comprehensive abilities, so as to increase their competitive advantages in society. Therefore, by combining modern food testing technology with the concept of “High order, innovative, and challenging”, we aim to build a core curriculum with great professional characteristics.

4.1. Higher Order: Multi-dimensional Development of Teaching Content

4.1.1. Setting up Miniature Virtual Simulation Laboratory

At present, due to the expansion of university enrolment, experimental equipment, and hardware equipment are relatively lagging, these result in students having not enough practical ability to fully meet the basic training needs of teaching laboratories[8]. At the course level, the examination experiment is the main body, the lack of mutual integration between different disciplines, the quality of experiential learning can not keep up with the development of new learning concepts, and there is limited space for broader development and innovation. Therefore, virtual simulation as a new medium of information technology can effectively contribute to the development of higher quality higher education.

Theoretical knowledge can not give students adequate problem-solving ideas, and students need to be allowed to combine theoretical knowledge with practical knowledge to improve their ability to solve complex problems through experiments, so that the knowledge of modern food testing technology can be fully absorbed by students.

Virtual reality technology environment, students can demonstrate safe and effective experimental operations, to complete the actual operation of the more difficult-to-access test process, which enhance the enthusiasm of students and greatly improve their operational ability[9]. Students can experience the actual operation process of the course of modern food testing technology, as well as more clearly understand the practical application of testing technology in all aspects of society, which can enhance the ability of students to apply and migrate knowledge, and solve the cognitive gap between basic theoretical knowledge and practice.

Some experiments with highly computerized technology (as shown in **Figure 1**) can increase students' horizons and at the same time promote the organic combination of students' theoretical knowledge and practical qualities.

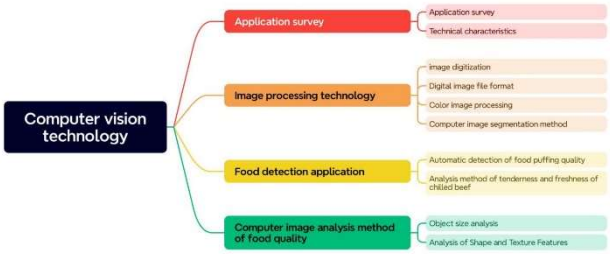

Figure 1. Schematic Diagram of Computer Vision Technology Experiment

Through the setup of a virtual simulation laboratory, students have a deeper understanding of food testing technology, a more fluent mastery of practical techniques, and a greatly enhanced ability to solve complex advanced problems, which fully meets the requirements of higher-order teaching.

4.1.2. Setting up Online and Off-line Combined Field Visits and Teaching Activities

At present, the teaching of modern food testing technology courses still stays at the stage of teaching mainly theoretical knowledge, supplemented by supporting experiments. The higher-order requirements in the context of the construction of the Golden Course require more changes in the teaching mode of colleges and universities, and the need to improve students' practical ability and problem-solving ability, theoretical knowledge is certainly the basis of all the ability to quality, but practical operation is also one of the abilities that students must have at present.

Students are relatively unfamiliar with the actual operation process of testing technology, and they are unable to link the theoretical knowledge they have mastered with the actual production operation process. Therefore, according to the actual production process of food testing technology, the actual content of the visit is reasonably designed, and the technical activities of different units are divided, so that students can widely apply the knowledge gained in production. Through extensive contact with the actual production, students are encouraged to combine the practical

problems encountered during the visit and study, apply the professional theoretical knowledge gained, collect the reference materials of related technologies, or humbly seek advice from technicians and staff, so that the problems can be solved and the students' self-learning ability, independent working ability, social practice ability and social ability can be developed and improved.

Visiting the field of teaching not only allows students to experience the practical application of course knowledge in advance but also enables them to understand the working environment in advance, fully embodying the concept of higher order, so that students in colleges and universities make full use of the resources to achieve the organic integration of knowledge and quality[10].

With the development of modern science and technology, new tools and equipment are constantly being developed, and technological tools are constantly advancing, students can obtain in-depth knowledge outside the classroom. Through the visit and learning of modern food testing technology courses, students' thinking level can be effectively improved and their ability to proficiently master modern food testing technology courses can be cultivated.

4.1.3. Integrating Ideological and Political Education with Interdisciplinary Knowledge in the Curriculum

In the actual teaching of the modern food testing technology course, due to the requirements of the higher order, it is necessary to cultivate the organic combination of students' knowledge and quality, and teachers need to start from a multi-dimensional perspective and fully analyze the students' cognitive law and learning ability to cultivate students' growth and success[11].

The teaching content of modern food testing technology is integrated into three major modules: physical testing technology, physical and chemical testing technology, and biological food testing technology. Full integration of ideological and political elements into the three modules. For example, in the teaching of physical indicators such as food color and texture testing, combined with the "Made in China 2025" strategy, emphasis is placed on the "craftsman spirit" behind precision instrument operation. When teaching pesticide residue and additive testing, embed ideological and political cases from the legislative process of the Food Safety Law, the historical lessons of incidents such as melamine was analyzed, and the legal concept of lawful testing was strengthen. In biological teaching such as PCR detection, combining with food traceability technology in the prevention and control of COVID-19 epidemic, the biosafety strategy under the "overall national security concept" is explained. All three modules are equipped with "Course Ideological and Political Workshop", which achieves the natural integration of professional knowledge and socialist core values through situational teaching such as "Warning Record of Data Fraud Detection" and "Rapid Detection Technology in Rural Revitalization".

China's socialist market economy continues to develop issues related to food security. Food is very different from ordinary commodities, and its quality is directly related to the health and life of consumers, and the security and stability of the country. Therefore, as a food person, it is especially important to develop business ethics. We can educate students on ethics, educate them, and train food practitioners to strictly follow food safety rules.

In short, what General Secretary Xi Jinping put forward in the report of the 20th Party Congress should be implanted in the classroom: "Promote the construction of a healthy China, put the protection of people's health in the strategic position of priority development, and improve the people's health promotion policy", so that students can understand and learn the spirit of the 20th Congress[12]. We would actively guide students to create a correct worldview, outlook on life, and values, while improving dialectical thinking skills in modern food testing technology courses. This not only improves students' moral code of conduct but also explores and cultivates students' knowledgeability in other fields, which is more in line with the requirements of the higher order.

4.2. Innovation: Parallel Implementation of Multiple Teaching Modes

4.2.1. Teachers Update the Teaching Content and Prepare the Lessons with New Concepts of Thinking

At this stage, the content of the teaching materials is more timely, and teachers should pay more attention to the unification and modernization of the curriculum, as well as the use of modern ideas in the process of preparing the text, so as to make the curriculum more vivid and make students feel the penetration of new ideas in the classroom process. Lesson preparation should strictly implement innovative concepts, as to improve the existing teaching stock on the basis of basic theoretical knowledge, and create new teaching methods centered on the students so that they can listen to the lessons with interest and absorb purposeful methods of knowledge[13, 14].

Modern food testing technology is developing into a "multi-level, open" innovative educational system based on "holistic, fundamental, comprehensive, practical and innovative" teaching. It contributes to the transfer of knowledge and the improvement of the teaching system when teachers prepare innovative programs. This approach helps to coordinate the knowledge and progress of theoretical and experimental courses to a higher level, and by incorporating knowledge into theoretical education and experimental training, students' abilities can be effectively improved, and learning outcomes can be enhanced.

4.2.2. Pair-split Classroom/Flipped Classroom

In the past, when teaching modern food testing methods, teachers usually use PPT slides to show each testing method in the theory, process stages, and application methods, which lacked the interaction between teachers and students. The traditional teaching method seriously affects the concept of innovative teaching and learning and fails to realize the innovation and interactivity of the teaching method, the teachers can't teach the knowledge to the students well, and the students can't get the knowledge they gained during the lectures. The knowledge gained by students in the process of listening to lectures is also very limited, therefore, it is very necessary to reform the teaching mode.

A dyadic classroom is an obvious subversion of the traditional teaching method [15], which was first proposed and initiated by Zhang Xuexin, a doctor at Princeton University and a professor of psychology at Fudan University. The core concept of the paired classroom is to divide the classroom time in half, with half of the time being spent on explanation by the teacher and half being spent on discussion by the students. The student's way of learning has changed, and they have learned the key points and difficulties of classroom teaching.

To help students find answers to their questions, teachers will also be able to have a more targeted approach to teaching, improve students' ability to analyze and solve problems and strengthen their memory and skills. In group lessons, students will be able to share their skills with their classmates, exchange views on issues related to each other, improve their language skills, enhance communication skills, and promote friendship among students; On the other hand, it is beneficial to break through the blind spots that arise when individuals think about problems alone, broaden their horizons, and often spark new ideas through the exchange and debate of different perspectives.

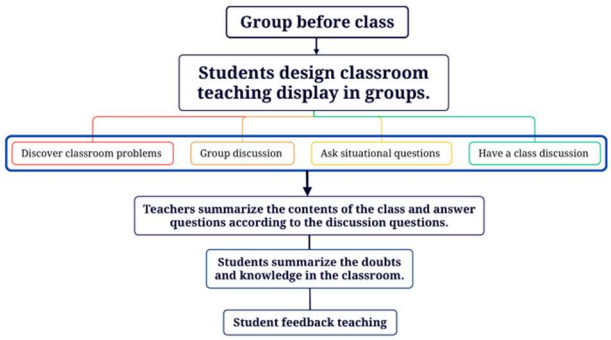

Figure 2. Diagram of Split Classroom/Flipped Classroom

Splitting classes is beneficial for strengthening communication between teachers and students. In traditional classrooms, there is little interaction between teachers and classmates. In the divided classroom, the increased frequency of teacher-student interaction is beneficial for teachers to have a better understanding of students' needs and ideas, so that they can design students' doubts into the course teaching, which can provide good answers to students' doubts and further enhance students' familiarity with the course learning, just as shown in **Figure 2**.

4.2.3. Increase Supporting Experiments

Since modern food detection technology is a course combining theoretical knowledge and practical operation. Behind the learning of theoretical knowledge, there is also a need for relevant experimental practice, so that students can operate by themselves, experience the process of food detection technology and the progressiveness of modern equipment, so that students can better understand the content of the course itself.

Moreover, in the requirement of "innovation", students' practical and exploratory abilities need to be emphasized in the classroom. In modern food testing technology courses, it is necessary to use experimental innovation to exercise students' exploration and innovation in course content[16].

At present, experimental designs are designed to enable students to understand the basic principles before they can complete them. However, under the guidance of innovative theories, we should not only enable students to understand the basic principles in experiments, but also develop more related experiments, so that students can truly experience the principles and applications of modern food detection technology in the process of hands-on learning.

In experimental design, it is necessary to encourage students to independently design and complete diverse experiments. Based on the existing experiments, students should be encouraged to divergently propose more new experimental designs according to the principles of food testing. During the experimental process, students should constantly reflect, try, and improve, enhance their interest, and cultivate their practical hands-on and innovative thinking abilities.

4.3. Degree of Challenge: Autonomous Design, Diversified

4.3.1. Assessment Introduction of Thinking Maps Design

A mind map is typically a topic oriented, organized, layered, radiating, and interrelated display material that perfectly showcases the combination of visual and logical thinking[17]. In the process of challenging learning, it is required to stimulate students' desire for exploration and make the learning process challenging, requiring students to take a leap in order to achieve it.

Previous cases have shown that the application of mind maps in curriculum development helps students acquire course knowledge in an orderly and systematic manner. The course "Modern Food Testing Technology" can be used to assist teaching by combining the characteristics of framework structure and knowledge. Teach students the concept of mind map design and encourage them to design mind maps hands-on, thereby improving their ability to organize and familiarize themselves with the framework of course content[18]. The classroom teaching process is shown in **Figure.3**.

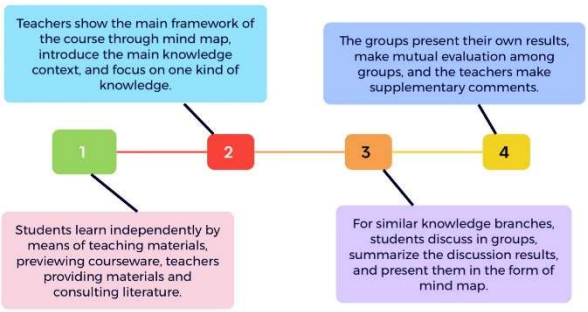

Figure 3. Classroom Teaching Process

Teachers can revise the teaching design according to the problems reflected in the mind maps designed by students and adopt diversified teaching methods for difficult-to-understand knowledge points, to promote students' rapid understanding of knowledge points.

4.3.2. Diversification of Course Assessment

Currently, the evaluation of students in higher education institutions should not be based on "one paper for life", but should be based on the development of human personality and the cultivation of innovative consciousness[19]. However, the current teaching methods are more often "single standard" and "uniform", which is in sharp contrast to the diversification of talents and the demand for diversified modes of growth of talents. Therefore, as a means of testing the level of education, the examination should also be changed, the ideological concept should be changed, and the examination system should be reformed, so as to stimulate the enthusiasm of both teachers and students.

At the same time, the group needs to produce high-level presentations and speak on stage to exercise logical thinking and comprehensive abilities[20]. In summary, the reform of assessment methods (**Figure 4**) has met the requirements of challenging both genders, stimulated students' interest in

learning, and truly improved the teaching quality of modern food testing technology courses.

Figure 4. Diagram of Assessment Methods

5. Conclusion

The ultimate goal of higher education is to push more talents for society, and need to cultivate students' self-learning ability, one of the important problems faced by teachers is to cultivate students' learning ability innovation and practical ability, rather than the traditional inherent teaching of theoretical knowledge to students.

In the context of the school's "first-class" construction, in the context of the construction of the "Golden Lesson", and under the guiding concept of " High order, innovative, and challenging ", we need to strengthen the intensity of curriculum reform, promote the progress of curriculum reform, and achieve the overall optimization of curriculum reform. Under the guiding concept of " High order, innovative, and challenging ", we should strengthen the intensity of curriculum reform and promote the progress of curriculum reform, so as to achieve the comprehensive optimization of curriculum reform and cultivate more applied research talents.

In the concept of "promoting the construction of a healthy China" put forward by General Secretary Xi Jinping, the curriculum reform of modern food testing technology is particularly important. The ultimate goal of the course is to provide excellent food testing technicians for society. Fully tapping into students' learning potential and cultivating their ability to learn and explore independently can ensure that students shine in the field of social food testing and make important contributions to the construction of a healthy China.

Moreover, enhancing students' ability to organically combine quality knowledge and guiding their creative ability and innovative consciousness, is also a way to expose students to professional industries in advance, enhance their professional awareness and ability, and cultivate them into applied talents with both morality and talent.

Acknowledgments

This work was supported in part by the grant from Undergraduate Teaching Reform Research Project of Shandong Province (No. M2025181, M2023021, Z2025250), Shandong Province Graduate High Quality Professional Degree Teaching Case Library Project (No. SDYAL2025093), Undergraduate Teaching Reform Research Project of Qilu University of Technology (No. 2025zd0, No. 2024zd12), Training Program of Innovation and Entrepreneurship for Undergraduates of Shandong Province (No. S202510431026X), Postgraduate Education Reform Project of Shandong Province (No. SDYJSJGB2025009), and Qilu University of Technology Craftsmanship Studio (No. GZS202601).

References

[1] Chi, Y., Nie, X., & Nie, L. (2026). Innovative exploration of talent cultivation in the food industry in the new era: taking the teaching of the course “Modern Food Testing Technology” as an example. Agricultural Product Processing, 11, 146–149.

[2] Ma, M., Chen, R., & Long, L. (2023). Characteristics and practical application of modern food testing technology. Food Research and Development, 44(08), 241–242.

[3] Zhou, W., Li, Y., & Liu, J. (2023). Teaching reform of natural medicinal chemistry program under the concept of “High order, innovative, and challenging”. Chemical Management, 32, 26–29.

[4] Wu, Y. (2018). Building China's “Golden Class”. China University Teaching, 12, 4–9.

[5] Sin, C., Tang, F., & Wei, C. (2010). Reform and exploration of production internship teaching in food science and engineering. Science and Technology Information, 30, 528.

[6] Fu, W., Shen, Y., & Yu, D. (2023). Reform and practice of teaching courses based on the standard of “High order, innovative, and challenging”—Taking “Garden Botany” of Environmental Design Major as an example. Education and Teaching Forum, 35, 125–128.

[7] Lai, R., Li, H., & Lin, Z. (2020). Innovation and improvement of collective class preparation system to enhance the quality of organic chemistry laboratory teaching. University Chemistry, 35(07), 8–12.

[8] Dai, T., Cui, Y., Wang, R., Han, J., Deng, L., & Chen, J. (2026). Exploring embodied integration of virtual simulation experiments in food science field. Food Industry, 47(07), 120–127.

[9] Wang, K., & Hu, C. (2023). Virtual simulation technology applied to blended teaching research. Science and Technology Wind, 01, 103–105.

[10] Gan, X., Wang, L., & Tan, C. (2023). Discussion on the reform of experimental teaching of power electronics under the background of “double carbon”. Journal of Science and Education, 11, 88–90.

[11] Tian, B., Meng, F., & Bu, T. (2023). Teaching design of food nutrition course based on the “High order, innovative, and challenging”. Food Engineering, 04, 59–61.

[12] Ping, G., Gong, L., & Wang, H. (2023). Research on the reform and construction strategy of the “tectonic geology” course under the viewpoint of “High order, innovative, and challenging”. Education and Teaching Forum, 26, 76–79.

[13] Zhu, B. (2022). Explanation of the core meaning and basic requirements of collective lesson preparation for college and university Civics teachers in the new era. J. Southwest Forestry Univ. (Soc. Sci.), 6(02), 6–10.

[14] Ye, T. (2026). Teaching reform empowerment mechanism and practical path of collective preparation for ideological and political courses in undergraduate vocational education. Modern Vocational Education, 14, 99–104.

[15] Yang, W., Fu, H., & Ni, W. (2023). A preliminary study on the application of paired classroom and contextual teaching method in the teaching of medical immunology based on “High order, innovative, and challenging”. Chinese J. Immunol., 39(10), 2238–2241.

[16] Li, Z., Zhao, Y., & Wei, L. (2020). The construction of applied undergraduate high-quality online open courses under the thinking of “High order, innovative, and challenging”. Applied Higher Education Research, 5(04), 75–80.

[17] Du, C., Liu, Q., & Peng, X. (2021). The application of mind mapping in the teaching of “food additives”. Agricultural Product Processing, 08, 90–93+96.

[18] Li, Z., Zhao, Y., & Wei, L. (2020). Construction of quality online open courses for applied undergraduate programmes

under the thinking of “High order, innovative, and challenging”. Applied Higher Education Research, 5(04), 75–80.

[19] Cheng, F., & Sun, J. (2023). Exploration and application of “High order, innovative, and challenging” standard in the teaching reform of chemical principle course. Innovation and Entrepreneurship Theory Research and Practice, 6(12), 11–13.

[20] Hao, L., Zhu, G., & Wu, X. (2022). Characteristic course construction of biomedical engineering major integrating the concept of “High order, innovative, and challenging”—A case study of ”Principles and Applications of Medical Instrumentation”. China Medical Education Technology, 36(02), 175–180.