Research on the Design of Blended Teaching of "Food Physical and Chemical Inspection" Course

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DOI: 10.32629/jher.v5i2.2399

Abstract: The blended teaching mode is a cutting-edge teaching approach in current higher vocational education. Compared with traditional teaching methods, it has advantages such as rich teaching resources, intuitive teaching methods, no time and space constraints, and strong student classroom participation. These advantages effectively stimulate students' enthusiasm for learning and improve classroom teaching effectiveness. This paper takes the core course "Food Physical and Chemical Inspection" of the higher vocational food inspection and testing technology major as an example. Based on online classrooms and simulation training platforms, a complete blended teaching design case is designed, covering pre-class preparation, in-class tutoring, post-class summarization, and reflection evaluation. Practice has proven that the blended teaching mode of online and offline fully utilizes teaching time inside and outside the classroom, mobilizes students' enthusiasm and initiative, and achieves the expected teaching objectives.
***Keywords*:** blended teaching; food physical and chemical inspection; teaching design

1. Background and Significance

Food is the most important necessity for people, and safety is the priority for food. Great importance are attached to food safety work and four "most" overall requirements have been proposed: the most rigorous standards, the strictest supervision, the most severe punishment, and the most serious accountability. Strengthening food safety inspection is a key measure in implementing the strictest supervision. The food inspection and testing technology major is an important branch of higher vocational food majors, and it is the main discipline for training food "inspectors." The "Food Physical and Chemical Inspection" course is the core course of the food inspection and testing technology major. Further strengthening the construction of the "Food Physical and Chemical Inspection" course is of great significance.

The blended teaching mode is a cutting-edge teaching approach in higher vocational education. In recent years, with the continuous development of information technology in China, the blended teaching mode has also been widely used. The "Food Physical and Chemical Inspection" course is a course that combines both theory and practice. Using the blended teaching method of online and offline can achieve twice the result with half the effort in teaching. This paper attempts to use the existing teaching environment of the college to study the blended teaching design around the "Food Physical and Chemical Inspection" course, hoping to provide more beneficial exploration for teaching in this field.

2. Blended Teaching Mode and Student Analysis

2.1 Blended Teaching Mode

The blended teaching mode refers to fully utilizing technologies such as the Internet, big data, and artificial intelligence to promote the combination of online and offline teaching, face-to-face teaching, and remote teaching, as well as theoretical teaching and simulated practice. The blended teaching mode emphasizes a student-centered approach by creating learning scenarios and establishing a positive environment to stimulate students' enthusiasm and initiative. It focuses on enhancing students' self-learning ability and innovation capacity. The blended teaching mode creates learning scenarios around online classrooms, interactive design, and simulated training, aiming to improve students' comprehensive abilities and their ability to flexibly apply knowledge and develop innovative skills.

The main process of the blended teaching mode includes the following steps: Before class, teachers use the school's online teaching platforms (such as Chaoxing and iCourse) to assign learning tasks. Students independently study the course content and take pre-class tests to assess their preview results. They can also use the platform to provide feedback on difficult issues. During class, project-based teaching methods, case teaching methods, and group discussions can be used to organize open teaching sessions. Teachers provide targeted guidance based on pre-class tests and feedback issues, encouraging students to practice boldly and engage in mutual exchanges. After class, teachers assign homework through the platform.

Students practice to reinforce and improve their understanding, and they create mind maps to form a systematic knowledge framework.

2.2 Current Teaching Status and Student Analysis of the Food Physical and Chemical Inspection Course

The Food Physical and Chemical Inspection course is a core course for the Food Inspection and Testing Technology major and is a discipline with strong theoretical and practical connections. It mainly studies the detection, analysis, and evaluation of nutritional components or toxic and harmful substances in food using physical and chemical methods. The teaching process involves not only various knowledge and theories but also a large number of experimental analysis sessions. The content is extensive, the testing projects are complex, and the teaching difficulty is high, placing high demands on students. Table 1 summarizes the teaching training objectives of the "Food Physical and Chemical Inspection" course.

Table 1. Teaching Training Objectives of the "Food Physical and Chemical Inspection" Course

No.	Training Objective	Specific Content
1	Knowledge Objective	Familiarize with the structure, usage, and maintenance methods of food-related testing instruments, and master the basic principles and methods of food testing.
2	Ability Objective	According to different inspection objects and purposes, use relevant standards and testing techniques to conduct independent, accurate, and efficient tests with reliable results; use various analysis software and tools for result verification and analysis, and conduct comprehensive food quality evaluation.
3	Non-technical Ability	Enhance food safety awareness, improve professional literacy in food safety, enhance self-learning ability, cultivate communication, coordination, teamwork, innovation, and professional ethics, promoting comprehensive and sustainable development of students.

Due to the unique nature of the Food Physical and Chemical Inspection course, the traditional "theory + practical training" model tends to keep theory and practice separate. The teaching method is often one-way and lacks interactive communication, resulting in low student engagement and limited teaching effectiveness. Furthermore, there is limited scope for improvement in achieving the established educational goals. Regarding practical training, due to limited school equipment, especially fewer high-end instruments such as gas chromatography-mass spectrometry and liquid chromatography-mass spectrometry, these instruments need to be shared among students, and some sophisticated instruments are only demonstrable by teachers, thus preventing students from hands-on practice, which affects teaching effectiveness.

3. Blended Teaching Design Ideas and Practical Paths for the "Food Physical and Chemical Inspection" Course

3.1 Assigning Teaching Tasks Before Class, Organizing Online Self-Learning

Before class, teachers use the school-level online teaching platform to release relevant teaching resources, including teaching PPTs, teaching videos, cloud textbooks, test questions, discussion questions, and other related content, organizing students for online preview. Students are required to watch the complete video or reach a certain number of study hours before conducting self-assessment of their knowledge. Through the discussion module, they can report difficulties and doubts. Teachers can understand students' test situations through the backend, collect and analyze key and difficult points, and prepare for targeted teaching during class.

3.2 Adopting Project-Based and Case-Based Teaching Methods to Increase Classroom Engagement

In the blended teaching mode, classroom teaching is no longer dominated by the traditional teacher-led approach. Teachers can adopt project-based learning (PBL) and case-based learning (CBL) methods according to the teaching objectives and content, combined with the pre-class preparation situation. They can use more group discussions and practical explorations as teaching methods. Teachers act more as organizers and guides, returning the main role of the classroom to the students. Students research and discuss independently according to predetermined research topics, consulting materials and conducting self-studies. Teachers provide timely Q&A and guidance, fully mobilizing each student's enthusiasm and encouraging active participation. Finally, for each group's discussion and research results, teachers can organize centralized research comments, select representative viewpoints, display them uniformly, and give praise and encouragement.

3.3 Fully Utilizing Simulation Experiments to Ensure Participation of Every Student

Virtual simulation is a training and teaching platform developed based on artificial intelligence technology. Leveraging this platform, students engage in highly realistic practical training operations, minimizing deficiencies caused by inadequate

sophisticated instruments and risks associated with hazardous substances. It addresses gaps in teaching resources and time. For instance, instruments like gas chromatography-mass spectrometry, liquid chromatography-mass spectrometry, and inductively coupled plasma can all be simulated for pesticide and precious metal residue detection. Virtual simulations replicate various teaching and practical scenarios, offering features such as video playback, process evaluation, comprehensive grading, and instructional guidance. Students can independently assess their experimental training progress based on system feedback, facilitating autonomous learning. For complex and expensive instruments, students can qualify through repeated virtual experiments before participating in real-world training, providing a hands-on experience. This integrated approach of simulation and practical training offers students ample opportunities for engagement, enabling continuous improvement and enhancement of practical skills, resulting in effective teaching outcomes.

3.4 Post-Class Summarization and Expansion, Consolidation and Improvement, Completing the Teaching Loop

The "Food Physical and Chemical Inspection" course is rich in content and highly practical, making extracurricular consolidation and expansion indispensable. After classroom teaching ends, teachers assign post-class homework through the platform. Theoretical assignments are answered online, while practical assignments can be completed through the simulation platform or by video recording laboratory work. The system can automatically grade objective assignments and videos, while teachers grade subjective questions. The system will automatically compile the results and push them to the teachers. Based on the assignment results, teachers can provide targeted feedback. Additionally, teachers can assign mind maps and summaries of cutting-edge detection technologies through the platform to consolidate and expand the learned knowledge. Students can anonymously provide feedback on classroom teaching issues and suggest improvements through the platform, allowing teachers to comprehensively consider and continuously improve their teaching methods.

3.5 Organizing Scientific Teaching Assessments and Conducting Diverse Teaching Evaluation Activities

The "Food Physical and Chemical Inspection" course tightly integrates theory and practice, necessitating a balanced assessment approach for both aspects, as well as for regular performance and final exams. Daily scores are calculated through the cloud platform system, based on student attendance, in-class tests, periodic tests, frequency of active participation, and practical performance, accounting for 60% of the final grade, while the final exam accounts for 40%. By optimizing the assessment system, student engagement in regular courses is increased, thereby improving teaching effectiveness. The final course evaluation should consider not only academic performance (knowledge and ability objectives) but also non-technical factors, such as the cultivation of professional ethics. Besides teacher assessments, the online platform can facilitate inter-group peer reviews and intra-group self-evaluations, enhancing the scientific and effective nature of the evaluations.

4. Case Analysis of Blended Teaching Practice in the "Food Physical and Chemical Inspection" Course

Using the topic "Determination of Lead Content in Food" from the "Food Physical and Chemical Inspection" course as an example, a blended teaching case is designed as detailed in Table 2:

Table 2. Blended Teaching Design for "Determination of Lead Content in Food"

No.	Stage	Specific Content
1	Pre-class Learning	Teachers assign learning tasks through the school's cloud platform, upload teaching videos, PPTs, and related literature, and set pre-study test questions and discussion topics. This includes textbook-related content, "National Food Safety Standard - Maximum Levels of Contaminants in Food" (GB 2762-2022), "National Food Safety Standard - Determination of Lead in Food" (GB 5009.12-2023), and simulation experiment demonstration animations. The pre-study goals are to familiarize with textbook content, understand relevant national standards and testing methods, grasp the working process of atomic absorption spectrophotometers, and have a preliminary understanding of the testing process and operation procedures. After pre-study, students complete the pre-class test as required and consider questions like the differences between the 2017 and 2023 standards and important points in experimental operations. Teachers adjust teaching focus based on the pre-study test results.

No.	Stage	Specific Content
2	Classroom Teaching	Classroom teaching uses the Project-Based Learning (PBL) method, divided into project introduction, project implementation, and project evaluation phases. Project Introduction Phase: Based on students' understanding of relevant national standards, a short video about excessive heavy metal content in food is shown. The research project for this class, "Determination of Lead Content in Tea," is introduced. Emphasis is placed on the principles of atomic absorption spectrophotometry, operational details, and important precautions. Project Implementation Phase: The teacher uses the simulation training platform for a live demonstration and organizes all students to practice 1-2 times on the platform to master the testing methods and experimental steps. Once the platform feedback indicates that students have grasped the methods well, practical training is organized. Students are arranged in groups to perform hands-on operations with real instruments, practicing repeatedly. The specific steps include installing the hollow cathode lamp, turning on the compressor and acetylene cylinder, adjusting instrument parameters, igniting, preparing samples, and collecting data. During operations, students proceed in groups, coordinating and cooperating. They can consult each other when encountering issues and revisit the simulation videos to resolve problems. Throughout the practical training, groups can also exchange ideas, summarize, evaluate, and correct mistakes to improve efficiency. The entire student experiment process is recorded for evaluation purposes. Project Evaluation Phase: During this phase, each group's operation videos are automatically assessed by the system, which identifies and scores higher error rates. Groups are encouraged to watch each other's videos, using evaluation criteria to learn from one another and collectively improve. The teacher conducts comprehensive assessments, integrating system-generated scores with peer evaluations. Typical issues and data discrepancies are analyzed, such as improper pretreatment, misplacement of sample tubes, inadequate sample tube cleaning, and inadequate flame temperature control.To address identified issues, optimization measures are implemented. The course content and data are shared with partnering companies for professional operations, enabling them to record and publish videos of procedures, which students can use for comparative learning and improvement.
3	Post-class Expansion	After classroom teaching, students conduct self-evaluation, and teachers release group scores, showcasing videos of the groups with the highest operational standards and smallest experimental data errors to encourage and motivate students. Students are assigned to create mind maps and post-class tasks (e.g., testing lead content in preserved eggs). Students test lead content in preserved eggs in groups, comparing results to national standards to consolidate and enhance knowledge.
4	Summary and Reflection	The course achieved the expected teaching effect. Compared to traditional teaching methods, student enthusiasm and participation significantly increased, and classroom feedback was positive. However, some issues remain: the complex operation steps of the atomic absorption spectrophotometer led to non-standard practices among students, necessitating further simulation training before hands-on practice. Additionally, some students lacked coordination and teamwork during experiments, highlighting the need for improved division of labor and collaboration.

5. Conclusion

Blended learning breaks away from the traditional one-way, lecture-based teaching model, deeply engaging students throughout the entire process from pre-class preparation, in-class learning and practical training, to post-class reflection and extension. It is particularly suitable for vocational courses where theory and practice are closely intertwined. The blended learning approach integrates online and offline activities, virtual simulations, and practical training to create a holistic learning experience of "learn, teach, practice, evaluate," effectively enhancing teaching effectiveness and warranting further promotion.

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