Discussion on Empowering Ideological and Political Teaching in Food Physical and Chemical Inspection Courses with Artificial Intelligence

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***Abstract*—Physical and chemical inspection of food is a core course in the major of food quality and safety, and plays a key role in cultivating students' professional skills and professional qualities. There are problems in the current course teaching, such as the teaching content lagging behind the development of industry technology, the integration of ideological and political elements being stiff, the limited resources of the practical platform, and the evaluation system being difficult to balance the assessment of skills and values. The rapid development of artificial intelligence technology provides new paths for curriculum reform. This paper, in light of the characteristics of the food physical and chemical inspection course and the requirements for ideological and political education in the course, explores the implementation paths of ideological and political education in the course empowered by artificial intelligence from five dimensions: reconstruction of teaching objectives, development of teaching resources, innovation of teaching models, optimization of evaluation systems, and upgrading of practical platforms. To construct a trinity teaching system of "technology empowerment – value guidance – practical innovation", aiming to cultivate "food safety guardians" with excellent inspection skills, rigorous professional ethics and a strong sense of social responsibility, and to provide practical references for the construction of ideological and political education in food-related professional courses.**

***Keywords*—artificial intelligence, food physical and chemical inspection, course-based ideological and political education, teaching reform, practical innovation**

I. Introduction

Food safety is a major strategic issue concerning the national economy and people's livelihood. Food physical and chemical inspection, as a key technical link to ensure food safety, its quality of talent cultivation directly affects the healthy development of the food industry. Food Physical and Chemical Inspection Technology, as a core course of the Food Quality and Safety major, not only undertakes the task of imparting professional skills such as food component analysis and harmful pollutant detection, but also shoulders the educational mission of cultivating students' professional qualities, engineering ethics and social responsibility. In accordance with the requirements of the "Guidelines for the Construction of Ideological and Political Education in Higher Education Courses", engineering practice courses need to strengthen engineering ethics education, cultivate students' spirit of great craftsmen who strive for excellence, and inspire their patriotic [1] feelings of serving the country through science and technology.

However, there are many limitations in the teaching of traditional food physical and chemical inspection courses: First, the teaching content focuses on traditional detection methods and has insufficient coverage of cutting-edge content such as rapid detection technology based on artificial intelligence, resulting in a disconnection between students' knowledge system and industry demands; Second, ideological and political elements are mostly integrated in the form of case indoctrination, lacking deep coupling with professional skills, which can easily trigger students' resistance; Third, practical teaching relies on physical laboratories and is limited by the number of equipment, experimental costs, and safety risks, making it difficult for students to carry out high-frequency and high-risk practical training. Fourth, the evaluation system focuses on experimental reports and skills assessment, making it difficult to comprehensively assess students' professional values and innovation capabilities [2].

The development of artificial intelligence technology offers new opportunities to solve these problems. Computer vision, virtual simulation and other technologies can enable dynamic updates of teaching resources, precise integration of ideological and political elements, immersive simulation of practical scenarios and intelligent upgrading [3] of teaching evaluation. Based on the concept of integration of positions, courses, competitions and certificates, this paper explores the teaching path of artificial intelligence empowering ideological and political education in food physical and chemical inspection courses, builds a teaching system with both technological innovation and value guidance, and provides new ideas for the cultivation of food-related professional talents.

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II. The Core Value of Artificial Intelligence Empowering Ideological and Political Education in Food Physical and Chemical Inspection Courses

(1) Promote dynamic teaching resources and enhance the timeliness of ideological and political elements

Food testing technology is evolving rapidly, and artificial intelligence can integrate cutting-edge industry resources and ideological and political materials in real time. For example, by tracking domestic and international food safety regulatory policies through big data technology, combined with intelligent case analysis of typical food safety incidents, students can understand the importance of food safety to social stability while mastering detection technology; Use natural language processing technology to extract the deeds of scientists in the field of food and generate visualized teaching materials to inspire students' patriotic [4] sentiments through science and technology.

(2) Personalize the teaching process and enhance the precision of integrating ideological and political education

Based on student profiling technology, artificial intelligence can accurately identify students' cognitive weak points and value tendencies. By analyzing students' experimental operation data, assess their level of craftsmanship development, and push targeted skill training programs and ideological and political cases; For students with a weak sense of professional identity, documentary images of food inspectors safeguarding public health are recommended to strengthen their sense of professional mission. In addition, the intelligent tutoring system can answer students' questions about testing ethics through real-time Q&A, achieving "teaching students according to their aptitude" [5] in ideological and political education.

(3) Innovate practical teaching scenarios to enhance the immersive experience of ideological and political education

Build virtual LABS where students can not only repeatedly practice professional skills through immersive operations, but also understand the importance of professional ethics in simulated scenarios such as "abnormal handling of test data" and "reporting of unqualified samples". Recreate the real working environment of a food testing laboratory in a virtual setting, allowing students to engage in role-playing as "guardians of food safety" to enhance their professional identity [6].

(4) Optimize the teaching evaluation system to ensure the effectiveness of ideological and political education

Traditional evaluation systems have difficulty quantifying the effectiveness of ideological and political education, and artificial intelligence can achieve a comprehensive assessment of "knowledge – ability – value" through multi-dimensional data collection. Computer vision technology is used to analyze the normativity of students' experimental operations to assess their rigorous spirit; Quantifying students' engineering professional qualities by combining their decision-making data in virtual scenarios. In addition, the intelligent evaluation system can generate personalized growth reports, visually presenting the progress trajectory [7] of students in dimensions such as craftsmanship and social responsibility.

III. The Teaching Implementation Path of AI-Enabled Ideological and Political Education in Food Physical and Chemical Inspection Courses

(1) Reconstructing the "three-dimensional integration" teaching objectives and anchoring the direction of ideological and political education

With "professional skills, professional ethics, and social responsibility" as the core, and in combination with the characteristics of artificial intelligence technology, reconstruct the teaching objectives of the curriculum. In the professional skills dimension, new objectives such as "mastering AI-based detection data processing methods" and "using virtual simulation systems to complete complex sample detection" have been added; In the professional ethics dimension, requirements such as "forming rigorous and standardized experimental habits" and "establishing standards-based testing ethics" are clearly defined; In the dimension of social responsibility, goals such as "being able to provide advice for food safety supervision based on test results" and "actively disseminating food safety knowledge" are proposed. For example, in the "Determination of Pesticide Residues in Food" unit, the three goals of "mastering high performance liquid chromatography detection methods", "understanding the harm of excessive pesticide residues to human health", and "cultivating a sense of mission to protect consumers' health" are deeply integrated [8] through artificial intelligence technology.

(2) Develop an AI-driven course resource library to achieve the coupling of ideological and political education with skills

Build a trinity resource library of "professional knowledge + ideological and political elements + intelligent tools", including: Intelligent case library: Integrate domestic and international food safety incidents, use AI technology to analyze the causes of incidents and detect technical loopholes, and provide ideological and political modules such as "Professional Ethics of Inspectors" and "Interpretation of Food Safety Regulations", allowing students to understand the symbiotic relationship between technology and ethics through case review.

Virtual simulation experiment resources: Build a virtual laboratory for physical and chemical inspection of food, covering the entire process of "sample collection – pretreatment – instrumental analysis – data reporting". In the virtual experiment "Detection of Heavy Metal Lead in Food", set up unexpected scenarios such as "abnormal instrument parameter alarm" and "data deviation from standard range" to guide students to apply professional knowledge to solve problems, while embedding ideological and political prompts [9] such as "Data authenticity is the lifeline of inspectors".

Intelligent teaching AIDS: Develop a food testing knowledge graph to associate and present testing methods, standards and regulations, and ideological and political elements. Through the graph, students can intuitively understand "why strictly follow the GB2763 maximum residue limit standard for pesticides in food"; Use AI tools to develop an intelligent Q&A system to answer students' questions in real time about "how to handle abnormal test data" and strengthen professional awareness.

(3) Innovate the "AI+BOPPPS" blended teaching model to deepen the integration of ideological and political education

Integrate the BOPPPS teaching model with artificial intelligence technology to build an immersive and interactive course-based ideological and political teaching process [10]. Take the unit "Detection of Illegal Additive Sudan Red I in Food" as an example:

Context Introduction (B): Generate virtual news videos through AI, simulate an event where a food company uses Sudan red to make chili sauce, present the entire process of sampling and testing by the market supervision department and laboratory data analysis, guide students to think about "the role and responsibility of food inspectors in the event", and stimulate learning interest.

Learning Objectives (O): Clarify knowledge objectives – Master the principle of high performance liquid chromatography-tandem mass spectrometry for detecting Sudan red; Ability objectives – Be able to use AI tools to analyze detection data; Value objectives – Establish a "zero-tolerance" attitude towards food safety testing.

Pre-school Test (P): Through Rain Classroom, intelligent test questions are distributed to examine students' preview of the hazards of Sudan red and the detection standard (GB/T19681-2005). The AI system automatically analyzes the answer data and generates a class weak knowledge point report.

Participation in Learning (P): Teachers use knowledge graphs to explain the testing process, focusing on analyzing key steps such as "sample pretreatment" and "chromatographic condition optimization", and embedding ideological and political prompts such as "operational errors may lead to misjudgment and affect consumer health"; Introduce AI data processing tools to allow students to compare the differences between human calculation and intelligent analysis, understand how technological innovation improves detection efficiency, and discuss "whether intelligent technology can replace human judgment" to cultivate dialectical thinking.

Post-study Verification (P): Students submit virtual experiment reports, and the AI system scores them based on three dimensions: data accuracy, report completeness, and reflection depth, and generates evaluation reports by analyzing ideological and political expressions in the reports through natural language processing technology; Teachers organize group presentations, with a focus on commenting on students' decision-making logic in "handling abnormal test results" to strengthen their sense of responsibility.

Summary (S): AI-generated unit knowledge graph and ideological and political element association graph, sort out the logical relationship of "Su Danhong detection technology – standards and regulations – professional ethics"; Teachers, in combination with industry cases, emphasize the importance of "honest testing" and encourage students to take practical actions to safeguard food safety.

(4) Build an intelligent evaluation system to improve the closed loop of ideological and political education

1. Process Evaluation:

(1) Intelligent skills assessment: Collect students' operational data through virtual simulation systems and quantify their craftsmanship using machine learning algorithms;

(2) Ideological and political behavior analysis: Use computer vision technology to observe students' teamwork performance during the experiment, and assess their sense of social responsibility in combination with their remarks on food safety incidents in online discussion forums;

(3) Real-time feedback: The intelligent evaluation system generates a "skills-ideological and political" two-dimensional growth curve and recommends "Food Inspection Team Collaboration case" learning resources for students who operate in a standardized manner but lack team awareness [11].

2. Summative Evaluation:

(1) Comprehensive skills assessment: Set the task of "Full Analysis of Unknown Food samples", students need to combine AI rapid detection technology with traditional detection methods to complete the entire process from sample processing to report issuance, and assess their comprehensive technical application ability;

(2) Ideological and political literacy assessment: Through AI simulation of ethical dilemmas such as "enterprise pressure to modify test data" and "test results involving local industrial interests", assess students' value judgment ability; Combined with second-class participation data such as "food safety volunteer" and "community testing service", a comprehensive assessment of the implementation of social responsibility is made.

(3) Value-added evaluation: Compare and analyze the changes in students' skill levels and ideological and political literacy at the beginning of enrollment and after the end of the course to assess the effectiveness of ideological and political education in the course and provide data support for teaching optimization [12].

IV. Teaching Practice Effectiveness and Reflection

(1) Practical effectiveness

Taking the students of the 2023 grade of the Food Quality and Safety major in our school as the experimental subjects, a one-semester teaching practice was carried out using the "Artificial Intelligence Empowering Ideological and Political Education in Courses" teaching model. Compared with the traditional teaching class (2022 grade), remarkable results were achieved:

Professional skills improvement: Experimental data showed that the mastery rate of AI-assisted detection

technology among students in the experimental group reached 85% (compared with 30% in the traditional group), the accuracy rate of sample detection increased by 20%, and the standardization score of experimental reports increased by 15 points (out of 100);

Enhanced ideological and political literacy: Through the questionnaire survey, the scores of "craftsmanship spirit", "professional identity", and "social responsibility" of the experimental group students were significantly higher than those of the traditional group ($p < 0.05$), among which the proportion of "willing to engage in the food inspection industry" rose from 45% to 78%;

Enhanced industry recognition: In the enterprise internship, the scores of "standard awareness" and "problem-solving ability" of the students in the experimental group were highly recognized by the internship enterprises, and the internship retention rate increased by 25% compared with the traditional group.

(2) Problems and reflections

Although some achievements have been made in teaching practice, there are still problems that need to be improved: First, the cost of developing artificial intelligence teaching resources is relatively high, and some small and medium-sized colleges and universities have difficulty bearing the cost of building virtual simulation platforms. It is necessary to explore the "school-school" and "school-enterprise" resource sharing mechanism; The AI application capabilities of teachers vary, and there is a need to enhance intelligent technology training for professional teachers and cultivate compound teaching teams of "AI+ ideological and political + professional". There are still limitations in the assessment of students' values by the AI evaluation system, and it is necessary to combine teacher observation, student mutual evaluation and other methods to achieve "human-machine collaboration" evaluation.

V. Conclusion

Artificial intelligence empowering ideological and political education in food physical and chemical inspection courses is an inevitable trend of the deep integration of technological innovation and educational reform. By building a teaching system that is "dynamic in resources, personalized in teaching, immersive in scenarios, and intelligent in evaluation", the collaborative cultivation of professional skills and ideological and political literacy can be achieved, and high-quality talents with both technical capabilities and a sense of responsibility can be provided for the food industry. In the future, it is necessary to further optimize the integration mechanism of AI technology and ideological and political education in courses, break through the bottlenecks at the levels of resources, teachers and evaluation, promote the construction of ideological and political education in food-related professional courses to a higher quality, and provide solid talent support for ensuring food safety and promoting the healthy development of the food industry.

Conflict of Interest

The authors declare no conflict of interest.

Author Contributions

Wei Jiang was responsible for the funding support of the research, undertook the drafting of the initial manuscript of the paper, and participated in the subsequent revision and refinement; Jiexin Duan and Luelue Huang jointly provided the core ideas and overall design scheme of this research; Xiaoting Li and Qingying Luo were in charge of the implementation of classroom practice in the research, and completed the collection, collation and statistical analysis of research data; Jing Li was responsible for the construction, operation, and maintenance of the artificial intelligence practice platform to ensure the technical support for the research; Bin Li undertook the exploration of ideological and political elements in the curriculum and the design of relevant schemes, and was responsible for the review of the final manuscript of the paper; all authors had approved the final version.

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