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Teaching Research and Practice of the Course of Analytical Instruments based on the Background of Ideological and Political Education

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Abstract: In order to effectively provide ideological and political education to students in the teaching process of analytical instrument courses, the master's students were taken as the research object in agricultural engineering at Tianjin Agricultural University. The ideological and political elements and moral education functions contained in the course were deeply explored and extracted in terms of the teaching content. The typical ideological and political cases were established, and the outline has been supplemented and revised. On this basis, the organic integration of ideological and political cases with professional knowledge is achieved through teaching design, and achieved the unity of explicit education and implicit education.

Keywords: Analytical Instruments; Teaching Research; Ideological and Political Education; Organic integration.

1. Introduction

In 2020, the Ministry of Education issued a notice on the "Guidelines for the Construction of Ideological and Political Education in Higher Education Courses". It is pointed out that ideological and political education should be integrated into the talent cultivation system, comprehensively promote the ideological and political construction of university courses, and improve the quality of talent cultivation in universities.

As a key high-quality talent cultivated by Chinese universities, the quantity and quality of graduate students should become a key issue of concern in higher education. From the perspective of ideological and political education in curriculum, many universities are actively exploring the integration of ideological and political elements into the teaching of graduate courses, in order to improve the quality of graduate education [1-4]. Hang et al. designed and integrated the invisible ideological and political teaching in the "Biophysics Professional English" course for graduate students, and achieved a resonance between knowledge transmission and value guidance [5]. Cai et al. proposed three paths for ideological and political education in graduate courses: embedded, supportive, and supplementary [6]. Song et al. analyzed the difficulties in cultivating graduate students under the background of ideological and political education in the curriculum, and provided optimization and improvement strategies [4]. He et al. studied the problems in the assessment system of graduate ideological and political courses, and pointed out that a modern, comprehensive, scientific, diversified, rational, and effective ideological and political assessment system should be established to improve the reliability and validity of the assessment in the new era [7]. Duan and Wu analyzed the four major factors that affect the effectiveness of graduate ideological and political education, and provided countermeasures and suggestions for improving the quality of graduate ideological and political education [8].

As a course for graduate students majoring in agricultural engineering at Tianjin Agricultural University, analytical instruments enable students to master the performance, technical parameters, basic principles and structures, installation and debugging and operating methods, maintenance and applications, to understand the new directions and development trends. The focus of the present paper is on how to incorporate ideological and political elements into the course of analytical instruments, so that students can subtly carry out ideological and political education while learning professional technical knowledge.

The paper focuses on master's students majoring in agricultural engineering at Tianjin Agricultural University in 2021 and 2022. The ideological and political teaching plan has been developed in terms of teaching content. The typical ideological and political cases have been established by deeply exploring and refining the ideological and political elements contained in the course. The outline has been supplemented and revised. On this basis, the ideological and political cases are organically integrated with professional knowledge through teaching design, for cultivating students' sense of social responsibility and mission. Integrating analytical instruments with other fields can cultivate students' scientific, dialectical, and innovative thinking methods and practical abilities.

2. Revision of the Outline

In order to implement the requirements of the school's "Implementation Outline and Teaching Plan for Integrating Ideological and Political Education into Curriculum", the teaching team has revised the curriculum outline, mainly focusing on how to explore ideological and political elements in analytical instrument teaching, as well as how to organically integrate with the curriculum for cultivating students.

2.1. Incorporating the Teaching Ideological and Political Plan into the Outline

By deepening the reform of course objectives, content, teaching mode, and other aspects, the content of the analytical instrument course was organically integrated with the cultivation of graduate students' scientific thinking methods,

dialectical thinking methods, innovative spirit, as well as ideological and political elements such as patriotism, cultural confidence, and institutional confidence. A teaching ideological and political plan has been formulated (Fig.1), actively promoting the construction of ideological and political courses.

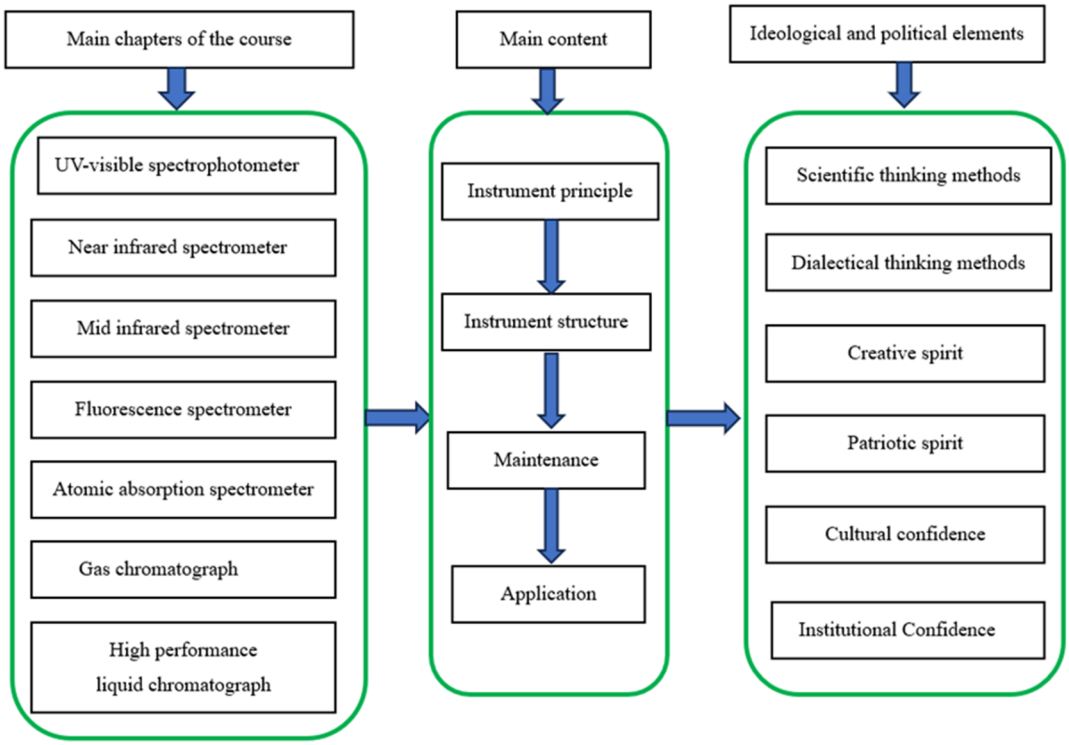


Fig 1. Teaching ideological and political plan

2.2. Incorporating Typical Ideological and Political Cases into the Outline

Integrating ideological and political education into the teaching of the course of analytical instruments" can cultivate students' scientific, dialectical and unified epistemology and methodology, improve their comprehensive analysis level and ability in understanding things, and establish a sense of mission and responsibility in scientific research and serving the country. The development process of analytical instruments can be integrated with ideological and political education. By introducing key events and people in the development process of analytical instruments, such as Nobel Prizes related to instruments (Table 1), students can be guided to recognize the hardships of scientific development and the importance of exploratory spirit.

Table 1. Nobel Prize related to analytical instruments

Number	Year	Awardee	Awarded project
1	1915	Henry Bragg	Design the first X-ray spectrometer
2	1922	Francis Willian Aston	Study on mass spectrometer (MS)
3	1924	Einthoven	Improving electrocardiograph
4	1926	Theodor Svedberg	Invention of super centrifuge
5	1939	Ernest Orlando Lawrence	Invention of cyclotron
5	1952	Arcger Martin, Richard Synge	Invention of distribution chromatography
6	1953	Frits Zernike	Invention of phase contrast microscope
7	1972	Stanford Moore, William H. Stein, Christian Borhmer Anfinsen	Developing an automatic amino acid analyzer
8	1979	Allan M. Cormack, Houns-field	Invention of X-ray tomography scanner
9	1981	Nicolaas Bloembergen, Arthur L. Schawlow	Invention of a high-resolution laser spectrometer
10	1986	Ernst Ruska, Gerd Binnig, Heinrich Rohrer	Design the first electron microscope
11	1991	Richard R. Ernst	Invention of fourier transform nuclear magnetic resonance spectroscopy
12	2002	John Fenn, Tanaka Koichi	Invented MS analysis method for biological macromolecules
13	2014	Eric Betzig, Stefan W. HellWilliam E. Moerner	Design the super-resolution fluorescence microscope
14	2017	Jacques Dubochet, Joachim Frank, Richard Henderson	Developed cryoelectron microscopy technology

3. Teaching Design of Course Ideological and Political Education

3.1. From the Point of the Core Components Research and the Development of Analytical Instruments, for Cultivating Students' Spirit of Fearlessness, Bold Innovation, and Responsibility

In the classroom of analytical instruments, the traditional teaching method is to introduce the development history of various instruments, but the content is very simple and allows students to perform a lot of memory work, which greatly reduces their interest. So, teachers should start teaching from the composition and structural characteristics of analytical instruments, the research and development of key core components, and the development history of the instruments. For example, in explaining the development process of infrared spectral instruments, students are aware of the importance of developing core components of spectrograph. It helps students understand theoretical knowledge and also enables them to understand the scientist's hardships and efforts in the development process of infrared spectral instruments. It can cultivate students' spirit of bold innovation and fearlessness.

3.2. From the Point of the Performance Indicators, Cost-Effectiveness, and Application Scope of Analytical Instruments, for Cultivating Students' Dialectical Thinking

The performance indicators of analytical instruments are key points in the teaching process, generally including sensitivity, detection limit, precision, accuracy, resolution, stability, linear range, etc. In the teaching process, students should master the concepts and meanings of various indicators, and clarify the dialectical relationship between the performance indicators of different instruments. At the same time, students are required to understand the functions and performance of different analytical instruments, grasp their respective advantages, disadvantages, and applicability, and be able to choose appropriate instruments and methods according to their needs in practical applications. For example, when explaining near-infrared spectral instrument, comparing the performance indicators and prices of different commercialized instruments enables students to have a dialectical understanding of the relationship between instrument indicators and prices, and to choose suitable instruments to meet application needs.

3.3. From the Point of the Application of Analytical Instruments in Various Fields, for Cultivating Students' Sense of Responsibility and Inspire Their Patriotism

Science and technology are the primary productive forces, and the level of technological development reflects a country's comprehensive strength. The analytical instrument industry can provide tools and methods for scientific researchers and quality control, and its technological level and production capacity can affect the speed of a country's technological development. Analytical instruments belong to a typical "bottleneck" industry. According to data from the General Administration of Customs over the years, the overall import rate of large-scale scientific research instruments in China exceeds 70%, with the import rate of analytical instruments exceeding 80%. The import rates of advanced categories such as chromatographs and mass spectrometers in analytical instruments were close to 90%. From the point of "bottleneck" technology, typical deeds of patriotic scientists were introduced for inspiring students to learn hard and use their professional expertise to make their own contributions for the fate of our country and humanity.

3.4. From the Point of the Daily Maintenance of Analytical Instruments, for Cultivating Students' Awareness of Laboratory Safety and Rigorous Scientific Research Spirit

The maintenance and upkeep of analytical instruments is an important part of laboratory management. A reasonable management system can ensure the normal operation of the laboratory, improve experimental efficiency and quality. In ideological and political cases, teachers should emphasize the precautions and risks involved in instrument operation, especially how to protect students from hazardous chemicals during experiments, and cultivate their awareness of experimental safety. Meanwhile, the maintenance and upkeep of instruments are inseparable from the rigorous scientific spirit. Good equipment maintenance can extend the service life of instruments, improve their stability and reliability, and thus better support scientific experimental research. Therefore, in the teaching process, cases of academic fraud are introduced, such as tampering or fabricating data to improve the accuracy of instrument analysis results, for cultivating students' rigorous scientific research spirit.

4. Summary

The ideological and political education was introduced into the teaching of instrument analysis course in preset paper. It cultivates students' scientific, dialectical and unified epistemology and methodology, and improves their comprehensive analysis level and ability to understand things by combining theory with practice. The ideological and political education enables students to establish a sense of mission and responsibility in scientific research and serving the country, truly achieving "teaching and educating people".

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