Strategies for Enhancing the Practicality of Vocational Undergraduate Courses Based on Job Requirements

Dandan Yao

Changchun Technical University of Automobile, Changchun, Jilin130000

Abstract: This paper focuses on the professional basic course "Metal Materials and Heat Treatment" in vocational undergraduate education. It analyzes the practical problems existing in this course from three aspects: industry standards, job requirements, and professional qualities. Based on the actual needs of the job positions, strategies to enhance the practicality of the course are proposed to improve the quality of vocational undergraduate talent cultivation, meet the needs of industry development, and provide high-quality applied talents for the fields related to metal material selection, processing, and quality control.

Keywords: Vocational undergraduate education; Metal Materials and Heat Treatment; Practicality of courses

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1.Introduction

1.1 Current Situation of Industry Development and Demand for Talent

Metal materials are widely used in various industries such as aerospace, national defense and military, automobiles, energy and chemical engineering, and medical devices[1]. Most of the metal materials used in these fields require heat treatment, especially in areas with extremely high requirements for part performance, such as aerospace and precision instrument manufacturing, almost all metal materials need to undergo heat treatment to meet specific performance requirements. The metal materials industry is moving towards the research and development of high-performance and lightweight materials, and the metal materials heat treatment process is developing towards greater efficiency, precision, and environmental friendliness.[2] Therefore, the manufacturing industry of metal materials requires talents with solid theoretical foundations and certain practical experience in technology and skills. Thus, higher requirements are placed on the knowledge, skills, and qualities of talents. So that after entering the workplace, they can meet the needs of enterprises, quickly adapt to their roles, and become designers, process engineers, quality engineers, etc. For example, in the manufacturing of aero engines, a large number of talents who master advanced heat treatment technologies are needed to ensure the performance optimization of key materials such as high-temperature alloys. Vocational undergraduate education, as an important way to cultivate such talents, shoulders an important mission.

1.2 Introduction to the Metal Materials and Heat Treatment Course

The Metal Materials and Heat Treatment course is a professional basic course. The course content is highly theoretical and involves the intersection of multiple disciplines, while also having a close connection with actual industrial production.[3] This course enables students to understand the relationship between the composition, microstructure, and properties of metal materials, be familiar with the principles and operation methods of various heat treatment processes, and understand the grades and applications of metal materials, laying the necessary foundation for the correct selection and rational use of metal materials; it also lays the necessary material design and process foundation for learning other subsequent courses in this major and engaging in mechanical design, manufacturing, and other work. The course consists of theoretical teaching and practical teaching. The theoretical part includes the basics of metal materials and the principles of heat treatment, while the practical part involves mechanical property experiments and metallographic experiments.

2.Problems in the Practical Aspect of the Course

In the teaching process of the Metal Materials and Heat Treatment course, when teaching theoretical knowledge, examples from the textbook are often used for explanation. However, these examples do not allow students to

understand deeply enough. As a result, students have difficulty adapting to the requirements of their jobs after graduation, which prolongs the training period for enterprises and may also affect the subsequent talent supply from the school to enterprises. Therefore, the practical aspect of vocational undergraduate education courses needs to be constantly updated and improved.

2.1 The Combination of Course Practice and Industry Standards

Metal material-related enterprises have relatively complete standard systems, including international standards, national standards, industry standards, and enterprise standards. Export projects may involve European standards, American standards, etc. The specific standards to be implemented depend on relevant contracts or technical documents. For example, the national standard GB/T 13304.1-2008: Steel Classification - Part 1: Classification by Chemical Composition, stipulates the basic principles for classifying steel according to chemical composition and sets the basic limit values of alloy element contents in non-alloy steel, low alloy steel, and alloy steel; the European standard EN10025-4: Hot-rolled structural steel products - Part 4: Delivery conditions for hot-rolled fine-grained structural steel products with thermomechanical rolling and welding, stipulates the requirements for hot-rolled fine-grained structural steel flat products and long products in the normalized/normalized rolled delivery state. These standards provide unified requirements for product design, process formulation, production processes, and quality control in enterprises.

However, in the current "Metal Materials and Heat Treatment" textbooks, some textbooks are not closely integrated with production practice, especially regarding the content of industry standards. Some textbooks never cover this part or do not cover it in depth enough. This part of the content is closely related to students' future work, as it represents the unified standards followed within the industry. Students need this industry awareness and technical reserve. For instance, when it comes to the classification of steel, some textbooks merely categorize it based on the carbon mass fraction, but the national standard stipulates that it is not only determined by the carbon mass fraction but also related to the content of other elements. There are also cases where the standards have not been updated in a timely manner, and the old standards are still being used. For example, GB/T232: Test Methods for Bending of Metallic Materials, after its version upgrade, not only reflects the latest achievements in the field of bending tests of metallic materials but also plays a significant role in ensuring the accuracy and reliability of test results.[4] Technicians who accurately understand and can skillfully apply the new standards can enhance their work efficiency and quality analysis capabilities. However, if the old standards are still used in experiments, students may cause deviations in test results and inaccurate data.

2.2 The integration of course practice and job requirements

Vocational colleges should set course content based on job positions and tasks as the logical starting point.[5] Through research on relevant positions in the metal materials industry, it is found that the main positions include design engineers, process engineers, quality engineers, quality inspectors, etc. These positions require employees to have a solid foundation in metal materials or heat treatment principles and be able to skillfully apply this knowledge to structural design, material selection, material forming, heat treatment process formulation, quality management and control, metal material performance testing and analysis, etc. At the same time, they also need to have good communication and collaboration skills as well as problem-solving abilities to deal with various complex situations that may arise randomly. Quality inspectors need to master the performance indicators and testing methods of various metal materials, such as metallographic analysis, hardness testing, etc., be able to accurately operate testing instruments, scientifically analyze testing data, and maintain an objective and fair attitude to ensure the accuracy of testing results.

Currently, there are still some gaps between the content and form of practical teaching and job requirements. In terms of practical teaching content, the types and quantities of production cases are not sufficient. During the teaching process, more production case contents corresponding to the positions should be designed based on the

theoretical content taught. For example, when teaching mechanical properties, related contents such as mechanical property calculations can be designed, and the teacher can explain from the perspective of a quality inspector or designer. Moreover, the current teaching is mostly lecture-based, with students passively learning. Students lack opportunities for independent learning and exploration, as well as the ability to solve practical problems, making it difficult for them to meet the job requirements for knowledge reserves and problem-solving abilities. In addition, the evaluation methods for students' learning and the assessment methods for talents in the workplace are different. In schools, the focus is generally on students' mastery of learned knowledge, while in the workplace, it is not only about the mastery of knowledge but also the assessment of the application of knowledge and the ability to handle random problems.

2.3 The combination of course practice and professional qualities

Professional qualities in the metal materials industry include multiple aspects such as professional ethics, professional awareness, and professional behavior. Professional ethics require employees to be honest and trustworthy, keep business secrets, and protect public property. Professional awareness includes quality awareness, safety awareness, etc. The quality of a product affects the future of an enterprise. Every employee must have a strong sense of quality. Whether they are designers or process engineers, when formulating relevant technical requirements, they must take meeting product quality as the premise and then consider the economy of the product. In addition, strictly follow the enterprise's safety operation procedures and pay attention to personal safety protection in the production site. Professional behavior is reflected in employees' execution of project plans and cycles, having a team spirit, and ensuring that special problems do not affect the project implementation progress and solving various production problems in a timely manner. The requirements for professional qualities of talents in enterprises are increasing. Good professional qualities can help improve work efficiency, ensure production safety, and enhance the enterprise's image.

At present, there are still some deficiencies in the current course practice teaching in cultivating students' professional qualities. During the teaching process, teachers pay more attention to the imparting of knowledge and lack targeted guidance on students' professional qualities. For example, a newly hired employee casually takes a photo of a new product that has not been publicly released and posts it on the public network, which is a serious lack of safety awareness and confidentiality awareness.

3.Strategies for enhancing the practicality of courses

3.1 Strategies based on industry standards

To make course practice better serve enterprises, the latest industry standards should be updated in the course practice teaching content in a timely manner, and the latest industry standards should be integrated into various teaching links such as production cases, experimental projects, and internship links, so that students can apply what they have learned and meet the industry's demand for talents. For example, in the metal materials mechanical property experiment, the sample preparation and test operation should be carried out in accordance with the latest industry standards to ensure the accuracy of the test data. This requires teachers to pay more attention to changes in industry standards. Once it is found that the cited standards have been upgraded, they should be updated immediately to ensure the validity of the industry standards and better support the development of the industry.

3.2 Strategies based on job requirements

To make the practical content more in line with job requirements. First, enrich the teaching content of course practice. Use typical job tasks related to metal materials, such as those of designers, process engineers, quality engineers, quality inspectors, etc., as production actual cases, allowing students to better combine theory with practice. For example, when a designer is required to "select gears for an automotive transmission", what factors should be considered? Not only mechanical performance indicators such as sufficient strength, good wear resistance,

and good toughness, but also processability and economy. Second, innovate teaching methods, such as using project-based teaching methods. During the teaching process, divide students into groups and assign tasks to each group, allowing each student to think carefully and work as a team - after group discussion, give the final solution, improving students' ability to solve practical problems. For example, let students conduct failure analysis, analyze the reasons for insufficient gear hardness, and then give solutions. Third, improve the teaching evaluation system. The evaluation system should not only be based on theoretical scores but also consider the evaluation of practical teaching. That is, not only written tests should be conducted, but also students should be evaluated in multiple dimensions such as their knowledge mastery, teamwork, and problem-solving during the teaching practice process, providing a comprehensive evaluation of students.

Strategies based on the improvement of professional qualities To effectively integrate professional quality education into practical teaching, the requirements of professional ethics, professional awareness, and professional behavior should be incorporated into the teaching content during the teaching process. First, when students are engaged in practical activities, they must be reminded to adhere to their professional ethics. If practical tasks are assigned to students, they must be carried out in accordance with the regulations, without taking shortcuts or engaging in fraud, and they must be honest and trustworthy. Second, during the practical process, attention should be paid to cultivating students' professional awareness. For example, when conducting material testing experiments, students must prepare samples and conduct tests in accordance with relevant standards or technical requirements to ensure the authenticity and validity of the test data, and to strictly control the quality, thereby continuously enhancing their quality awareness. Third, during the practical process, attention should be paid to cultivating students' professional behavior. Each student should be required to participate in the formulation of project plans, and each time a project report is made, students should take turns to present, ensuring that each student can collect the ideas of other students and organize their language well. This not only exercises students' teamwork ability but also enhances their expression and problem-solving skills.

4.Conclusion

This paper deeply analyzes the problems existing in the practical teaching of the "Metal Materials and Heat Treatment" course in vocational undergraduate education from three aspects: industry standards, job requirements, and professional qualities, and proposes corresponding improvement ideas and implementation strategies. This can effectively enhance students' practical abilities and professional comprehensive qualities, and improve the teaching quality of vocational undergraduate education.

With the continuous development of the metal materials and heat treatment industry and the ongoing reform of vocational undergraduate education, in the future, more attention should be paid to the new requirements of industry new technologies and new processes for practical teaching of the course, and the course content and teaching methods should be continuously updated and optimized.

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