ISSN 2522-6398 Vol. 6, Issue 2: 19-23, DOI: 10.25236/FER.2023.060204

Discussion on the Teaching Reform of the Engineering Course "Material Surface Technology"

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Abstract: *The course "Material Surface Technology" is an important professional technical course in materials. However, due to the comprehensive nature of the course and the diversity of techniques, there are many types of design materials. The content of the course is abstract and complicated, which requires students to have a good basic knowledge of materials. According to the characteristics of this course and its teaching objectives, this paper discusses the reform of the course content, teaching methods, experimental practice and examination methods. In the teaching process, practical engineering cases are used, which makes it easy for students to master various material surface technologies, improves the teaching quality of this course, and helps to train students to become application-oriented talents with strong practical ability.*

Keywords: *Material Surface Technology; Course teaching; Application case; Teaching reform*

1. Introduction

Teachers in colleges and universities shoulder the important mission of training high-level talents for socialist modernization. At present, China is moving from a large education country to a strong education country.[1] In this process, higher education, as the leader of education, plays an important leading role. As the foundation of teaching work in colleges and universities and the support point of discipline construction and development, the level of curriculum construction plays a vital role in both the quality of education and teaching in colleges and universities and the level of personnel training, and it plays a very important role in the reform of higher education.

"Material Surface Technology" is an important professional course for the major of material physics. Surface technology is the technical foundation of many advanced industries such as new materials, new energy, and microelectronics. Humans have a long history of using surface technologies.[2] As early as 3,500 years ago in the Shang Dynasty in China, the technology of tin-rich copper plating on the bronze surface was invented to improve the appearance and corrosion resistance of the bronze surface.[3] The main task of this course is to enable students majoring in materials science and engineering to master the meaning, content, application and development of material surface technology, and to be familiar with the characteristics, scope of application, typical equipment, process measures and application examples of various surface technologies; Understand the methods of surface technology design and surface test analysis; understand the development history, current situation and latest developments in the field of surface technology at home and abroad. To enable students to initially have the basic literacy and ability to carry out relevant professional scientific research, and to lay a theoretical and practical foundation for future scientific research in the field of materials science and engineering.

"Material Surface Technology" is both theoretical and practical. In the process of teaching, teachers should not only ensure that students master the organizational structure of materials and the theoretical knowledge of various surface technologies, but also enable students to learn to use the knowledge they have learned. The performance, characteristics and requirements, and the various laws clarified should also train students to use the theoretical knowledge they have learned to solve practical problems.

2. Current status and problems of the course

(1) The traditional teaching mode is mostly based on teacher's explanation and students' memorization, with more passive listening and less active interaction and participation. Knowledge can only be remembered for a short time, and it is difficult to get a mastery of it in future practical applications.

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(2) In addition, the content of this course contains many meanings, concepts and other abstract theoretical knowledge, and the content of practical application is less. Most of the students are driven by grades, and they are not interested in relevant knowledge.

(3) The teaching content is not closely related to the development of surface technology in the world, and some of the teaching materials used cannot track the most cutting-edge technology in time.

(4) The course assessment is mainly based on written examinations, lacking the assessment of students' comprehensive ability.

In view of the problems in the course education of "Material Surface Technology", such as rigid teaching methods, disjunction between basic theory and scientific research practice, and too single assessment index, this paper optimizes the classroom education mode of this course by using various teaching methods. Through the teaching reform, teachers should pay attention to the cultivation of students 'practical ability and the ability to think and solve problems actively. The content of teaching reform mainly includes updating the course content in time, adopting various teaching methods, integrating experimental practice into daily teaching content, adopting the assessment mode of peacetime + experiment + written examination, etc.

3. Curriculum teaching reform and practice

3.1. Keep pace with the times and introduce cutting-edge knowledge

With the rapid development of high technology in the 21st century, material surface technology is also changing with each passing day, and new technology production equipment and testing equipment are also constantly updated and improved. With the further interpenetration and intersection of various disciplines and technologies, the improvement, compounding and innovation of surface technology will be more rapid, and the application field will continue to expand. Therefore, the teaching content of the course should also conform to the technological development trend and be constantly updated. [4] In order to allow students to fully understand the research status and development trends of material surface related technologies, in each technical chapter of the teaching, according to the corresponding content, the latest scientific research trends are collected and sorted out, and the students are introduced to the research trends of material surface technology and the academic thinking mode of scientific research. The latest surface technology research results, future development directions, and teachers ' new discoveries and new methods in the scientific research process are added to the teaching. For example, in the automotive industry, chromic anhydride passivation is often used for surface passivation of metal parts. This system has serious environmental protection problems due to the content of the first-class carcinogen $Cr^{6+,}$ and this technology has been gradually eliminated in the real society. In European and American countries, most of them use the chemical composite nickel process now. This process does not contain lead, hexavalent chromium, cadmium and other dangerous components. These new knowledge enriched the teaching content, broadened the knowledge of students, enhanced students'self-confidence in learning, stimulated students 'strong interest in exploring relevant knowledge, and also enabled students to have stronger adaptability to work. Therefore, in the teaching process, teachers need to check the latest developments in scientific research in a timely manner, update the teaching content, and introduce the most advanced and cutting-edge academic developments to students. This can help students better learn material surface treatment technology and achieve the purpose of teaching with learning and learning with fun.

3.2. Complementary improvement of multiple teaching methods

The purpose of improving teaching methods is to urgently improve the learning needs of students, so as to scientifically and efficiently master knowledge and scientific thinking in the process of discovery, which can be used to solve problems and explore new technologies. [5] There are common problems in curriculum education such as rigid teaching methods and disconnection between basic theory and scientific research practice. According to the teaching content of each chapter, corresponding teaching cases have been initially established. The knowledge points will be imparted in the class, especially the abstract theoretical part will use the comparative method. For example, by comparing the difference between ordinary anodizing and micro-arc oxidation, it can help students remember.

In addition, through the dynamic video demonstration method, practical case thinking method and group discussion method, the students are extended to guide students to diverge their thinking, stimulate

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students' interest in learning, and improve their learning enthusiasm and cooperation ability. Deepen students' understanding of abstract concepts by inserting dynamic video demonstrations during breaks. When teaching surface treatment technologies such as chemical vapor deposition and chemical nickel, students are shown videos of actual production processes. Through the explanation of practical application, the transformation from knowledge teaching to quality training is completed, and students' innovative thinking is cultivated. For another example, when teaching anodic oxidation, by watching the complete process of anodic oxidation of aluminum alloy, students can effectively understand the whole implementation process of pretreatment, oxidation system structure, dyeing and hole sealing of anodic oxidation, which is helpful for students to master anodic oxidation process. This combination of practical courses and theoretical teaching will help students to better grasp the knowledge of textbooks.

Group learning is adopted, and students are divided into groups of 5-8 people. After each knowledge point is completed, they can learn from each other through discussion and communication within the group or between groups, teamwork, learning from each other, and cultivating team spirit. Through technology-improved teaching methods, we will transform indoctrination classrooms into dialogue classrooms, from closed classrooms to open classrooms, from knowledge classrooms to ability classrooms, from emphasizing learning and despising thinking to combining learning and thinking, and from emphasizing teaching and despising learning to master-based learning.

Combine innovative activities with classroom teaching. Combining teaching and competition projects, students 'innovative ability of researching and improving material surface treatment technology is cultivated, and the mode of integration of innovative activities and teaching is realized, so as to promote each other. For example, encourage and mobilize students to participate in research and study in project activities such as innovation and entrepreneurship of college students and subject competitions, and arouse interest in innovation by sharing and summarizing experiences in project research. In order to improve students 'ability and innovative spirit, relevant national departments and schools have carried out a series of innovation activities and competitions in recent years, including college students' innovation and entrepreneurship training program, challenge cup, Internet + and other innovation and entrepreneurship competitions.[6] Teachers can adopt "embedded" and "integrated" methods to realize the integration of innovation and entrepreneurship with surface technical knowledge, instead of taking innovation and entrepreneurship education as an accessory and parasite of professional education. Teachers with engineering background can use the cooperation between schools and enterprises to develop the practical curriculum mode of innovation and entrepreneurship curriculum oriented by enterprise and industry practice. [7] Combine the topics of relevant innovative activities that students participate in, and integrate the surface technology-related equipment and methods used in the innovative activities into the classroom teaching. [8] For example, the SRT project applied by some students in the classroom is: Preparation of surface corrosion-resistant ceramic coating based on 3D printing aluminum alloy parts. In the classroom teaching process, when we talk about the chapter of anodic oxidation, the transformation process of aluminum surface during anodic oxidation, the formation mechanism of film, the change of microstructure, composition and performance of film are integrated in the teaching process. Thus the innovation education is practiced and the teaching effect is greatly improved.

3.3. Combination of classroom knowledge and experimental practice

Since the teaching content of the material surface technology course mainly focuses on material surface treatment technology, the importance of practical teaching is particularly prominent.[9] Experimental teaching can not only enrich the classroom content, but also improve students' interest in learning. Use the existing experimental equipment such as sand blasting, chemical vapor deposition furnace, anode/micro-arc oxidation tank in the department to carry out practical experiment demonstration and operation. In the form of experimental tasks, students are allowed to design experiments in groups and participate in material characterization, so as to improve their positive thinking and hands-on practical ability. In terms of experimental content, two parts can be set up: coating material preparation demonstration experiment and coating material characterization test. In the process of material preparation demonstration experiments, daily objects can be given priority to experiments, such as the surface oxidation treatment of aluminum spoons in the daily cafeteria, titanium alloys to obtain different appearance colors, so that students can learn closely the composition of electrolytes for preparing thin films on metal surfaces, The effect of process parameters such as concentration, temperature, current density, and time on the film. In order to stimulate students'sense of interest, increase enthusiasm for learning, and then encourage students to think about the selection and design ideas of surface treatment methods for magnesium alloys, stainless steel and other metal materials. In the coating material characterization test, commonly used coating characterization methods such as thickness testing,

ISSN 2522-6398 Vol. 6, Issue 2: 19-23, DOI: 10.25236/FER.2023.060204

hardness testing, friction and wear testing, surface microstructure analysis, and elemental composition analysis can be selected. On the one hand, this experiment corresponds to the teaching content. On the other hand, this experiment content can best reflect the characteristics of surface engineering technology. It further develops students' understanding of theoretical knowledge in the field of surface technology. Through this teaching method of combining experiment and theory, students' interest in learning has been greatly increased, and the teaching quality of this course has been improved.

3.4. Reform of assessment methods

Reform the assessment method and implement diversified assessment. The course focuses on process evaluation, evaluation of students' theoretical knowledge, innovation ability, and experimental ability, and establishes a diversified assessment plan to enable students to have independent thinking and innovation capabilities.

(1) Strengthen the management of intermediate links, increase the proportion of daily grades in the total score, focus on group discussions, literature reading and report speeches, and establish a comprehensive evaluation standard system for instructors to score internal inspections of the group.

(2) Strengthen the proportion of experimental results, pay attention to the evaluation of experimental norms, including operation norms, data recording norms, writing norms, etc. At the same time, advocate the diversification of experimental results, and encourage students to write academic papers and patents based on experimental results.

(3) Design a part of the test question bank around a knowledge point by grouping students into groups according to chapter knowledge points, build a student test paper question bank, cultivate students' independent learning and self-management abilities, and focus on passing some essay questions and subjective questions. The divergent thinking ability of students can directly promote the improvement of students' innovative ability.

(4) Establish a perfect performance scoring system to comprehensively assess the comprehensive ability of students. In the past, the assessment of this course was usually based on the final examination results as the decisive grade. The student's final grade is also mainly determined by the paper score of the final exam. However, such an assessment method has a large number of accidental factors and cannot fully assess the students' mastery of the course.

In this curriculum reform, try to adopt the ternary assessment method of usual + experiment + written examination. See Table 1 for the final grade evaluation method. Regular grades account for 30% of the total grade. In addition to attendance and homework completion, the usual grades also include group ranking scores, literature reading and speech report scores. This can not only improve the student's class attendance rate, but also improve the students' cooperation ability and communication ability. The experimental assessment accounts for 15% of the total grade. At the same time, the experimental practice examines the students' hands-on ability and improves the students' innovative ability. The final exam accounts for 55% of the total grade. The types of exam questions include multiple-choice questions, fill-in-the-blank questions, calculation questions and open-ended questions.

Table 1: Performance evaluation index

Usually	Experiment	Written exam
30%	15%	55%

4. Conclusion

The course "Material Surface Technology" has the characteristics of rich content and strong practicability, and the technology involved is developing very rapidly. Based on the analysis of the current situation and existing problems of the course, this paper explores four aspects: teaching content, teaching method, experimental practice and course assessment method. Keeping pace with the times, new surface engineering technologies and new equipment are updated to teaching content in a timely manner, supplementing cutting-edge teaching content that attracts students' interest in learning. Using a variety of effective teaching methods, a new creative program with students as the main body has been constructed. Through the practical links that are more closely related to practical applications, theoretical knowledge and practice are closely connected. Finally, a more comprehensive assessment method for evaluating students' learning ability is proposed. In this way, the task of personnel training is better completed, the educational effect is improved, the comprehensive ability of students is comprehensively

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improved, and the employment competitiveness of students of this major is further improved.

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