Region - Educational Research and Reviews, 2023, Volume5, Issue6
DOI: 10.32629/rerr.v5i6.1520
ISSN Online: 2661-4634
ISSN Print: 2661-4626

Thoughts and exploration on basic courses of materials science under the background of new engineering disciplines

Yuebin LIAN, Yannan ZHANG, Min ZHENG, Weilong XU, Jin XIAO

Changzhou Institute of Technology, Changzhou 213032, China

Abstract: The basic course of materials science is the most important professional course in the new energy science and engineering major. In order to adapt to the future career plans of students in this major and the changes in enterprises' demand for talents, and based on the talent training positioning and training goals of Changzhou Institute of Technology's new energy science and engineering major, the teaching model for the "Fundamentals of Materials Science" course was developed. According to classroom practice, it is found that through the improvement of teaching methods, students' enthusiasm in class is fully mobilized, and their understanding of knowledge and learning efficiency are improved.

Key words: teaching reform; talent training; "Fundamentals of Materials Science"

1 Introduction

Materials science is an interdisciplinary subject involving physics, chemistry, mathematics and other disciplines, which is an important part of new engineering. At the same time, the new materials industry, which incorporates the advanced results of many contemporary disciplines, is the basic industry that supports the development of the national economy and is also the material basis for the development of other types of high-tech industries[1][2][3]. The "Fundamentals of Materials Science" is a compulsory course for cultivating materials engineers and is of great significance for improving students' comprehensive quality and innovation ability. In order to cultivate high-quality applied talents needed for local economic and social development, Changzhou Institute of Technology adheres to the school philosophy of "letting everyone be creative and applying what they learn", and is guided by local industry needs and employer needs. The training of professional talents in the new energy direction is oriented towards the new energy industry, and the demand for materials science-related knowledge is also essential. At the same time, this course is also the study of subsequent courses such as material characterization and technology, thin film material basics, etc., as well as students engaged in related fields, which is also the basis for related work in the field of new energy and the basics of materials science, including basic knowledge of material structure, crystal structure, crystal defects in materials, phase structure and phase diagram of materials, solidification and diffusion of materials and solid-state phase changes, etc [4]. However, this course has problems such as scattered knowledge points, abstract content, and high learning difficulty. The teaching content will involve many highly theoretical derivation formulas and theorems, as well as some obscure spatial thinking and logical analysis. At the same time, the speed at which students can absorb new knowledge is limited and can easily be interrupted.

However, the traditional teaching model is difficult to capture students' attention by monotonously teaching in a full-class manner, which leads to students' tendency to wander off during class, not being deeply impressed by the knowledge they have learned, and having insufficient understanding of the coherence of knowledge. This often cannot meet the requirements of the new engineering era and requires reform and innovation.

2 Research on teaching models

Based on the experience in the teaching process and starting from the background and characteristics of new engineering, this article discusses the thinking and exploration of the teaching model of basic materials science courses, and puts forward the following suggestions:

2.1 Introduce project-oriented teaching method

As a teaching model with project as the core, project-oriented teaching method emphasizes that under the guidance of teachers, students complete a project task with practical significance through independent or cooperative methods, thereby achieving the comprehensive development of knowledge, skills and attitudes. Project-oriented teaching method is conducive to cultivating students' innovation ability, teamwork ability, problem solving ability and independent learning ability. It can also stimulate students' learning interest and motivation and improve learning effect. The implementation of project-oriented teaching method requires teachers to design appropriate project topics and tasks based on course objectives and student characteristics, formulate clear evaluation standards and processes, organize and guide students to carry out project activities, provide timely feedback and support, and finally evaluate project results.

For example, in order to improve students' learning interest and initiative, this article presents a case of introducing project-oriented teaching method, that is, with the theme of "Designing an Efficient Electrocatalytic Material", students are organized to work in groups and conceive from the materials, raw material selection, performance mechanism analysis, processing methods, application scenarios and other aspects to conduct comprehensive design. Teachers can guide students to see things from different angles. For example, the first characteristic of an electrocatalyst is conductivity, so metal or carbon materials with good conductivity can be the first choice. The second step is the contact between the catalyst and the electrolyte, that is, the catalyst must have a high specific surface area, so that the catalytic sites are more fully exposed. Thirdly, the composition of the catalyst should be considered, like which metal has better catalytic performance and has moderate adsorption capacity for the reactants. Finally, students are guided to consider the issue of catalyst lifetimes. The teaching objectives, teaching content, teaching process and teaching effects of this case, as well as the problems encountered and solutions during the implementation process should be listed. This article aims to provide a new idea and method for basic teaching of materials science, stimulate students' innovative consciousness and practical ability, and cultivate students' engineering literacy and teamwork ability.

2.2 Introduce the inverted classroom teaching method

The inverted classroom teaching method is a teaching method that inverts the traditional classroom teaching model, allowing students to learn course content independently through an online platform before class, and conduct discussions, exchanges, practices and other activities in the classroom. This teaching method can improve students' initiative, creativity and collaboration skills, while also saving teachers' teaching time and improving teaching efficiency and quality. Here are some examples of inverted classroom teaching methods:

Taking the phase diagram in the basic teaching of materials science as an example, students are first assigned tasks to investigate the ancient iron smelting process and understand what normalizing, quenching, tempering and annealing are. Let students proactively understand the process of quenching and explore with questions why the flexibility of quenched iron decreases and the hardness increases. At the same time, let students independently investigate the differences between

tempered glass and ordinary glass, and discuss in groups the differences between the production processes of tempered glass and ordinary glass. In this way, students have a certain understanding of metal solidification, which also reduces the difficulty of their learning. In addition, students can have questions and a desire to explore knowledge, and they can have a more sense of involvement in subsequent lectures and have a better understanding of the class. Therefore, knowledge points are more interesting, and it is also conducive to activating the classroom atmosphere and significantly improving classroom efficiency.

2.3 Introduce case analysis teaching method

Case analysis teaching method is a teaching method that uses real or fictitious cases as teaching materials to guide students to analyze problems, propose solutions, discuss and evaluate. Case analysis teaching method can cultivate students' analytical ability, innovation ability, communication ability and teamwork ability. It can also stimulate students' learning interest and motivation and improve teaching effect. It can combine the development history and cutting-edge trends of materials science, select some representative and inspiring cases, guide students to analyze and discuss, and cultivate students' critical thinking ability and innovation awareness.

For example, the plot of the movie *Titanic* is introduced in the teaching process, and then extended to the reasons for the sinking of the Titanic, step by step, so that students can understand the inevitability of the sinking of the Titanic and the hidden problems in it. It is inferred that the final conclusion is that shipbuilding steel is brittle and will break and form a huge gap after being hit by an iceberg. Then students are further guided to analyze the material forging process. Why do materials show high hardness and brittle characteristics? How to improve the forging process to avoid the above-mentioned tragedies and so on. Through the analysis, presentation, discussion, summary and evaluation of cases, students can independently analyze the causes of material failure, think about the mechanism of material performance regulation and find countermeasures to inhibit the degradation of material performance. Subsequently, the advantages and precautions of the case analysis teaching method are further analyzed and discussed. It is found that compared with full lectures, this method can better capture students' attention. There has been a significant drop in students holding their cell phones in class and not paying attention.

2.4 Introduce evaluation system reform

The evaluation system is one of the important factors affecting teaching effectiveness. Traditional evaluation systems tend to focus too much on test scores and ignore process evaluation and comprehensive evaluation. In order to adapt to the reform of the teaching model of basic courses in materials science under the background of new engineering, it is necessary to establish an evaluation system that conforms to the characteristics of new engineering. It must assess not only the level of knowledge mastery, but also the level of ability development, and assess both individual and team performance.

In the process of course assessment, the "N+1" model is adopted instead of the traditional final exam. The assessment process is more diversified and comprehensively examines students' learning abilities and qualities from multiple perspectives. One of them is the final exam, and N is the number of credits for the course. The credit of the basic course of materials science is 3 points, and its assessment method is a final examination and three types of process assessments. According to the teaching needs of this course, this article redistributes the three process assessments as follows:

A. Daily homework, accounting for 20%. After each chapter is taught, students are assigned certain homework to judge their mastery of knowledge points.

B. In-class test, accounting for 20%. In the teaching process, in-class tests are introduced to enable students to use the knowledge mastered in class, avoid students' rote memorization, and cultivate students' ability to use knowledge flexibly.

C. Summary of course knowledge points, accounting for 10%. At the end of the semester and before the final exam,

students are assigned the task to summarize the knowledge points of the course and the knowledge points learned in a semester. While helping students review, it also allows each student to sort out the logic and focus of the entire course from beginning to end.

D. Final exam, accounting for 50%. Examine the knowledge points of the entire course. Through the implementation of the "N+1" evaluation system, students' continuous learning ability has been improved, which is in line with the positioning of the materials science curriculum system.

3 Conclusion

In short, in the context of new engineering, basic courses in materials science need to think and explore teaching models to adapt to the needs of the development of the times and improve the quality and effect of education. Therefore, teachers should have sound teaching ideas and assessment methods, which can effectively improve students' learning efficiency, consolidate students' learning knowledge, activate the classroom atmosphere, and achieve better teaching and learning effects.

Conflicts of interest

The author declares no conflicts of interest regarding the publication of this paper.

References

[1] Wei DB, Sun ZJ, Yao ZJ, et al. 2021. Practical exploration of the ideological and political teaching reform of the "Basics of Materials Science" course. *Education and Teaching Forum*, 13: 59-62.

[2] Xie CZ, Zhang TW, Lu HS, et al. 2023. Exploration and practice of teaching reform of the "Fundamentals of Materials Science" course. *Guangdong Chemical Industry*, 50(02): 204-205.

[3] Wang LY, Wu CK, Liu XP, et al. 2022. Exploration and practice of ideological and political teaching reform in the context of new engineering--taking the "Fundamentals of Materials Science" course as an example. *Education and Teaching Forum*, 16: 68-71.

[4] Yi JY, Yang XX, Xiang YH, et al. 2022. Teaching reform and practice of "Fundamentals of Materials Science" course. *Guangzhou Chemical Industry*, 50(03): 144-145.