

# Teaching Practice of Integrating Literacy Education into Material Science and Engineering Course

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**Abstract:** In order to promote the integration and unity of knowledge education and value education, and gather the joint efforts of educating people. The collaborative efforts of cognitive logic, emotional logic, and behavioral logic in value education were achieved, and the integration of value education in materials science and engineering teaching was studied. This article takes the course of materials science and engineering as an example, combining imparting professional knowledge with shaping students' values. By enabling students to understand the basic concepts and theories of the composition, organizational structure, preparation process, and material properties of different materials such as metals, ceramics, and polymers, and mastering the basic teaching objectives of traditional knowledge points such as crystal structure, crystal defects, and material phase change, the course content is designed. The reform of assessment methods will integrate the shaping of students' values into teaching, guide them to form correct values and cultural views, guide them to firmly implement the school motto, and consciously shoulder social responsibility and historical mission. Integrate the educational goal of cultivating high-level leadership talents into the curriculum. Through teaching reform, activate the genes of curriculum education, and integrate knowledge transmission into deep thinking. National sentiment and profound understanding of meaning fill one's inner world.

**Keywords:** Materials Science, Educational Elements, Core Values, Crystal Structure

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## 1. Introduction

Materials Science and Engineering is a fundamental course that students majoring in materials must study before entering the professional curriculum. The main research focuses on the common laws of materials, the interrelationships between material composition, microstructure, preparation process, and performance. Guide the design and application of materials. To lay a solid theoretical foundation for subsequent professional courses, material research, and engineering technology work. The course has the characteristics of multiple knowledge points, multiple concepts, and strong theoretical significance [1]. The knowledge involving mathematics, physics, chemistry, mechanics and other disciplines is complex. Through course learning, one can develop, select, and use appropriate technologies, resources, modern engineering tools, and information technology tools for complex engineering problems such as composition,

microstructure, process design, and performance characterization in metal materials, inorganic non-metals, and related fields, including prediction and simulation of complex engineering problems. It plays an important role in cultivating materials talents [2].

This article focuses on the knowledge and ability goals of materials science and engineering. Through the design of teaching methods and strategies, combined with expected learning outcomes and course assessment methods, it explores the integration of typical cases and professional knowledge points to shape students' value in course learning. Encourage students to establish a correct outlook on life, values, and the world while learning professional knowledge [3, 4]. Practice the educational goal of cultivating leadership talents with lofty aspirations, moral integrity, innovation and inclusiveness, and a sense of responsibility for the times in teaching.

## 2. Course Objectives

### 2.1. Knowledge Objectives of Course Learning

Through learning this course, students are required to be able to understand the basic characteristics of bonding, crystal structure, phase composition, crystal defects, diffusion, material deformation, recrystallization, solidification, alloy phase diagrams, and metastable states of metal, inorganic non-metallic, and polymer materials. Able to prepare and process design metal, inorganic, and non-metallic materials based on the understanding of the above knowledge combined with subsequent relevant courses.

Students should acquire the ability to analyze the interrelationships between the microscopic characteristics and macroscopic mechanizations of materials through teaching and discussion. They are able to analyze, deduce, and judge the macroscopic response of materials with specific microstructures, as well as the microscopic mechanisms of materials exhibiting macroscopic phenomena. They are also able to make deep and broad summaries.

### 2.2. Extract the Key Points of Value Shaping and Integrate Them into the Teaching Process

In the course teaching, value shaping, ability cultivation, and knowledge impartation are regarded as the new curriculum objectives of "Materials Science and Engineering". Implement the principles of cultivating people with morality, adhering to moral principles, learning with morality, and teaching with morality in teaching. Emphasis should be placed on strengthening education on students' worldview, outlook on life, and values, inheriting and innovating excellent traditional Chinese culture, actively guiding students to establish correct cultural views, achieving the educational goals of "lofty ideals, profound academic knowledge, strong physique, and peaceful mood", and achieving the organic unity of literacy education and knowledge system education. Strong physique, and peaceful mood", and to achieve the organic unity of literacy education and knowledge system education. Cultivate students who meet the development needs of the field of materials science and engineering, possess good literacy and professional ethics, a high sense of social responsibility, active academic thinking, and the courage to practice and innovate. They can be competent in scientific research, product design, and manufacturing in the field of materials science and engineering [5-7].

### 2.3. Sorting out the Value and Shaping Educational Elements Contained in the Curriculum

Education with ideals and beliefs as the core teaching content, achieving the following ability goals.

By learning the status and role of materials, one can grasp the development laws of things, cultivate honesty and trustworthiness, and firm ideals and beliefs. Expand students' thinking and horizons, cultivate their innovative and practical abilities, and enhance their legal and environmental awareness.

In the study of material classification and basic attributes, representative achievements from the School of Materials Science and engineering are introduced to cultivate students' cultural confidence and enhance their professional confidence.

By combining the micro mechanism of diffusion and integrating explicit and implicit education, we aim to cultivate students' rigorous academic attitudes, encourage them to think and innovate, and enhance their ability to see through phenomena and essence.

Linking the impact of material strengthening and toughening on performance with the universality and particularity of contradictions, as well as the unity of opposites, to cultivate students' good dialectical thinking.

## 3. Methods and Contents for Shaping Students' Literacy

### 3.1. Introducing the Achievements of Scientists in the Field of Materials into Teaching

Through cases of basic knowledge and application technology of materials, students can fully understand the connotation and extension of materials science and technology, and deeply understand the dialectical relationship between dedication and personal growth [8-10].

In the introduction section, the role of materials in social development and the connotation of materials science are introduced. In the teaching, outstanding achievements and characteristic cases of Chinese scientists and scientific achievements are integrated into the classroom, and the spirit of science and scientists is passed down to students, inspiring their sense of national pride.

Professor Fuchi Wang, the leader of the Impact Environment Laboratory in Beijing Institute of Technology, has been working for a long time in the research and teaching frontline of high strain rate service materials and high-temperature and high-energy protective coating materials. He silently adheres and inherits tirelessly, closely combines personal pursuit with social needs, solves multiple scientific foundation problems of high strain rate service materials, breaks through technical difficult problems in material development, and realizes innovation and engineering applications of material systems. Driven the development of high strain rate service materials. Through Professor Wang Fuchi's deeds, we guide students to firmly inherit the spirit of scientists and consciously shoulder the historical mission of promoting scientific and technological progress. Cultivate high-level leadership talents who are knowledgeable, have a broad foundation, seek truth in depth, and are inclusive and innovative.

### 3.2. Combining the Knowledge Points of Materials Science and Engineering with Shaping Students' Values

Taking the teaching content as the core, introducing characteristic cases in the form of pictures, videos, etc., and consciously guiding and encouraging students to participate in

discussions. Actively explore the educational resources of characteristic cases, continuously enrich the expression forms of characteristic cases, and promote the effective integration of curriculum teaching and shaping students' values through curriculum. To achieve the educational goal of cultivating students' professional literacy while enhancing their moral literacy, and achieving the goal of cultivating morality and cultivating talents [6-12].

When teaching crystal defects, introduce the formation, characteristics, and impact on material properties of defects such as points, lines, and planes within crystals by raising questions, deriving calculations, and providing examples. There are always various defects in materials, which have a significant impact on the performance of the material. Therefore, it is necessary to achieve different performance by regulating the generation and quantity of defects. Defects have a significant impact on the physical properties of materials such as thermal conductivity, resistance, and optics. It also greatly affects the mechanical properties of materials such as strength, plasticity, etc. However, if defects are properly utilized, it can improve the performance of a certain aspect of the material. If artificially doping semiconductor materials to form holes, it can greatly improve the performance of semiconductor materials. To cultivate students' dialectical thinking in viewing things.

When learning material classification and basic attributes, use video format to introduce Professor Zhuang Ma's team technology case. The team conducted research on the technology of high-energy laser protective coating materials in response to the urgent demand for high-energy laser protective coating materials. Mastered the design and preparation of raw materials for new high-temperature and high-energy protective coatings, integrated design of coating structure function, and reliable prediction of coating life, breaking through key technologies such as ceramic coating strengthening and toughening, coating macro and micro structure control, dimensional stability of large-sized thin-walled irregular parts, and coating quality uniformity control. Using this case study to cultivate students' ability to serve social needs, assume social responsibility, and enhance their innovative awareness.

When explaining the principle of diffusion, combined with the microscopic mechanism of diffusion phenomena, diffusion can be understood as when the concentration of various parts inside a substance is uneven, during the process of molecular thermal motion, the number of molecules diffusing from high concentration areas to low concentration areas is greater than the number of molecules diffusing from low concentration areas to high concentration areas. The result of this exchange is the transport of substances from high concentration areas to low concentration areas. At the micro level, diffusion phenomenon is the process by which molecules transport mass during thermal motion. Combining with the micro mechanism of diffusion, through the integration of explicit and implicit education, it cultivates students' rigorous academic attitude, encourages them to think and innovate bravely.

When teaching the properties of materials, the relationship between strength and toughness is introduced. For most structural materials, strength and toughness are crucial, and they are usually mutually exclusive. Materials with high hardness have higher strength, while materials with good plasticity have better toughness. Although the exploration of stronger and harder materials continues. Low strength materials have higher toughness and can be used in most critical safety applications. Premature fracture or catastrophic fracture damage are unacceptable in these applications. Due to these reasons, the development of material strength and toughness has traditionally been a compromise between hardness and plasticity. Linking the impact of material strengthening and toughening on performance with the universality and particularity of contradictions, as well as the unity of opposites, to cultivate students' good dialectical thinking.

### ***3.3. Introducing Engineering Cases into the Course***

Teaching the application of materials in the field of engineering can be carried out through engineering cases that pursue the spirit of seeking truth, practicality, and excellence as craftsmen [13-15]. The Titanic collided with an iceberg in the North Atlantic and sank two hours and forty minutes later. The main reason for the sinking was due to defects in the steel plate material of the hull itself. When it collided with the iceberg, the steel changed from toughness to brittleness, and the hull quickly fractured due to insufficient toughness. At that time, a large amount of sulfide was added to increase the strength of the steel plate during steelmaking, which increased the cold brittleness of the steel plate, leading to the tragedy of the sinking of the Titanic. Ultimately, it is closely related to the quality of the material. Taking this as an example to cultivate students' sense of responsibility and professional ethics, enabling them to understand the importance of materials and the principle that details determine success or failure. This can then emphasize to students the important value of the spirit of continuous improvement as a craftsman for individuals and society.

### ***3.4. Shaping Students' Values Through Course Experiments***

Before the experiment, organize students to learn laboratory rules and safety regulations. Encourage students to strictly comply with laboratory requirements, do well in experimental protection, enhance safety awareness, take good care of instruments and equipment, and attach importance to experimental procedures. During the experiment, the teacher explained in detail to the students the experimental operating standards, safety precautions, and methods for analyzing the experimental results. Enable students to understand the experimental background and standardize the use of experimental instruments. Observe and record experimental phenomena, and cultivate good scientific research literacy. Do not waste experimental resources and do not litter or dispose of experimental waste. Conduct professional literacy education based on this. In organizational observation

experiments, combined with relative content measurement and analysis, cultivate students' ability to independently solve problems and their spirit of craftsmanship. In the experimental report, students are asked to analyze the relationship between the composition, structure, and performance of iron carbon alloys, in order to improve their analytical ability and engineering awareness.

## 4. Reform of Assessment Methods

### 4.1. Assessment Method

How to reasonably evaluate the effectiveness of materials science in shaping students' values requires the establishment of an evaluation system for materials science in shaping students' values. Establishing an evaluation system for shaping students' values is beneficial for testing the implementation effect of teaching concepts, identifying and correcting the problems in the construction process of curriculum ideology, and promoting the implementation of curriculum ideology teaching concepts by teachers. Therefore, it is necessary to establish an evaluation system for curriculum ideology.

When designing a basic assessment system for materials science, a diversified whole process evaluation system is constructed by combining process evaluation with summative evaluation.

### 4.2. Assessment Content

The basic assessment content of materials science should focus on paying attention to the changes in students' emotions, thoughts, values, etc. during the learning process, evaluating their enthusiasm for course learning, recognition of the value of the subject and profession, and their professional responsibility and sense of responsibility.

The ideological expression of the course reflected in the classroom and homework is evaluated through the submission of material science based classroom thinking reports, group discussion reports, and other methods by students. In teaching evaluation, the teaching goal of curriculum ideology focuses on building curriculum ideological identity, shaping correct life, worldview, values, etc., without emphasizing mechanical memory of knowledge content.

In teaching, the emphasis is on triggering students' ideological resonance and emotional touch, in order to achieve effective integration of curriculum ideology.

## 5. Conclusion

Curriculum ideological education is a new requirement put forward by the country and society for higher education in the new era. It is an important measure to cultivate high-level leadership talents who are "clear in morality, broad in foundation, profound in seeking truth, and inclusive and innovative". In the teaching process of materials science and engineering courses, the deeds and engineering cases of scientists in the field of materials are introduced, and

educational resources are actively explored in the knowledge points of materials science. Course ideological education is implemented in experiments to help students establish correct outlooks on life, values, and the world.

Integrating value shaping and ability development into the teaching of Materials Science and Engineering can cultivate the sense of mission and responsibility of materials students, enabling them to fully understand the connotation and extension of materials science and technology. Cultivate students' innovative thinking, rigorous scientific research awareness, and teamwork spirit.

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