

# *Practical Teaching Reform of Metallic Materials Engineering Based on the Cultivation of Undergraduates' Ability of Innovation and Entrepreneurship*

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**Abstract:** Innovation and entrepreneurship education is an important part of the current reform of higher education. In the higher education system, practical teaching and innovation and entrepreneurship education have similarities. Practical education contains innovation and entrepreneurship education, and innovation and entrepreneurship education can't be separated from practical teaching. By building and improving the practical teaching system, enriching the content of practical teaching and reforming practical teaching methods, the students can broaden the horizon of practical learning. It improves the effectiveness and interest of practical learning, and finally realizes the education of cultivating and enhancing college students' innovative and entrepreneurial abilities.

## 1. Introduction

In higher education, practical teaching is characterized by intuition, practicality, comprehensiveness, creativity, and the times. It is an important teaching method for implementing theory and practice, improving hands-on ability, mastering scientific methods, and fostering innovation and entrepreneurship. Innovation and entrepreneurship education is also an important part of the current reform of higher education. The ultimate goal is to cultivate and upgrade college students' innovative and entrepreneurial abilities. In the system of higher education, practical teaching and innovation and entrepreneurship education have similarities. Therefore, it has become a consensus of all parties to cultivate students' ability to innovate and start a business through practical teaching. Practical teaching is gradually developed and perfected along with the progress of the times. There are bound to be some problems and deficiencies. For example, problems such as the imperfect practice teaching system, ineffective implementation of practical teaching and improper practice teaching methods will inevitably restrict the cultivation of innovation and entrepreneurship. It is imperative to carry out reforms. Through the reform of practical teaching of

metal materials engineering with the goal of cultivating innovation and entrepreneurship, we adhere to the principle of insisting on practical teaching, strengthening practical teaching, improving the practical teaching system, and reforming the content of practical teaching, and effectively improve the effectiveness of practical teaching. We will cultivate advanced talents in materials engineering with innovative and entrepreneurial capabilities to meet the needs of the times in the country's modernization, new industrialization, and innovative country construction. This article analyzes and discusses the practical teaching reform research of metal materials engineering based on the cultivation of undergraduates' innovative and entrepreneurial ability by studying the present situation and problems of metal materials engineering production practice.

## **2. The Current Situation of Production Practice in Metal Materials Engineering**

Production internship is an important part of the practice class for college students in engineering colleges and is one of the effective ways to improve students' practical ability. Through production internships, students can not only improve their ability to analyze problems and solve problems, but also deepen their understanding of the professional knowledge they have learned. They also accumulate preliminary experience for students to quickly adapt to job requirements after graduation. Therefore, production practice plays an irreplaceable role in the cultivation of undergraduates and is of great significance for the cultivation of innovative and applied-type compound talents. However, from the effects of the current production internships, due to various reasons, the effect of production internships is not satisfactory. Combining with the actual teaching of metal materials engineering in our school, the author analyzes and summarizes problems in production practice, proposes improvement measures, and practices in teaching to further improve the quality of production practice and personnel training. The metal material engineering professional production internship is arranged in the sixth semester for a period of three weeks. The practice base is Changchun No. 1 Automobile Manufacturing Factory, Harbin Measuring & Cutting Tools Factory, and Harbin First Tool Factory. These internship units are not only professionally matched with students, but also have well-equipped production facilities and unique features. For example, at Changchun No. 1 Automobile Manufacturing Plant, students focus on internship casting and heat treatment. Casting has one cast, two cast, special cast, non-ferrous cast, etc., while heat treatment is mainly based on chemical heat treatment (carburizing); and Harbin Measuring & Cutting Tools Factory and Harbin First Tool Factory mainly studied the heat treatment (salt bath) of tool steel. The equipment and production techniques of these practice bases cover the professional knowledge they have learned and play a positive role in broadening their horizons and improving their practical ability.

## **3. Problems in Practical Teaching Production Practice in Metal Material Engineering Specialty**

With the development of our country's economy and the adjustment of industrial structure, especially the restructuring of higher education majors and the expansion of enrollment scale, colleges and universities have also made corresponding adjustments to the teaching content and training programs, and traditional production practice methods have also been greatly impacted. The internship effect is not satisfactory.

Professional structure adjustment and the impact of enlarging enrollment scale the predecessor of metal material engineering in our school is the professional of casting and heat treatment. Before the professional adjustment, the production real-time, casting students go to the foundry, and the

heat-treatment students go to the heat treatment plant. After the professional adjustment, the majors of casting and heat treatment were merged into metal materials engineering, and casting and heat treatment became the two directions of the profession. This allowed students to learn both casting and heat treatment during production practice. With the tricks of recent years, the original casting and heat treatment professionals each recruit one class each year, and now the metal materials engineering major enrolls 3 to 4 classes each year, which brings certain difficulties to the organization and implementation of production internships.

Under the condition of market economy, enterprises' enthusiasm for accepting students' internships has declined. Enterprises aim to create economic benefits, act according to market economic laws, and are generally reluctant to accept students' internships based on considerations such as production order, personal safety, and technical confidentiality. Even if students are allowed to practice, they are all visiting internships. Students do not have the opportunity to be allowed to practice. Workers implement a performance-based wage system and have no time to answer students' questions. Students can only act as a spectator on the sidelines. Serious students will carefully look at and record more. Students who are not serious will be lazy and slip away from the sidelines. Without the practical hands-on practice of students, it became a practice visit [4,5].

Inexperience of teachers, lack of systematic and targeted practical teaching materials. In recent years, the department has more retired teachers. New teachers have higher theoretical standards, but lack practical experience. This is mainly caused by the current education system in China. Most of the teachers who have entered colleges and universities are doctors who have just graduated from the school. From school to school, they lack the experience of working at the frontline of the company [6]. Therefore, when young teachers are instructing production internships, they often lack experience and influence the effectiveness of internships. In addition, there is a lack of systematic, targeted practical teaching materials. We still use teaching materials of the 1990s. Due to the renewal of factory equipment and technology, these teaching materials are no longer suitable for the actual situation of the factory. However, the preparation of internship teaching materials cannot be separated from the involvement of school teachers and business personnel. Due to the lack of practical ability of university teachers, the enthusiasm of enterprise staff is not high, it is difficult to write high-level, targeted teaching materials.

#### **4. Measures for the Practical Teaching Reform of Metal Material Engineering Major**

In view of the problems existing in the production practice in recent years, after many investigations and detailed discussions, combined with the characteristics of metal materials engineering, we proposed the following reform measures and carried out the practice.

1) Careful organization, fine management. Effective organization and management are important guarantees for successful internships. With the expansion of the enrollment scale, the number of students participating in the internship has increased. Under such circumstances, careful organization of each link in the internship process is particularly important. In the production practice, we will move forward and explain to students the importance of the internship, the safety, the content of the internship, the schedule of the internship, etc., so that the students can make full mental preparations and facilitate internship management. In order to guarantee the internship effect, the production process and equipment operation video of the main product of the internship unit (beforehand preparation) may be broadcasted before the internship; the students may also be divided into groups according to the internship contents, and each teacher is responsible for a group, cycling through groups, so that each group of students has the opportunity to perform internships in

all the departments.

2) School-enterprise cooperation, establish good cooperation with enterprises. Enterprises are reluctant to accept student internships. This is a common phenomenon. Northern enterprises are more serious than southern enterprises. In response to this situation, first of all, to make full use of the professional status and influence of the profession, to establish a good relationship with the company by solving the actual problems for the company on the basis of the research cooperation of the school and enterprise. Secondly, hire a part of engineering masters who have studied and graduated from this major and who have both a high theoretical level and rich practical experience to serve as part-time mentors to guide undergraduates or master students, so that they can keep in touch with the school and bring students to work. The training is considered as its their responsibility. Thirdly, with enterprises, joint declarations at all levels (for example, at the national level, provincial level, etc.) of university students' extracurricular internships (practice) bases, and outstanding engineer education programs shall be supported by policies and funds, so as to increase the enthusiasm of enterprises. In accordance with the above-mentioned thinking, we have established a stable practice base, including a national-level off-campus practice base and a provincial-level engineering excellence program. As more and more companies take up more social responsibilities, the phenomenon of unwillingness to receive student internships will gradually improve.

3) Improve the teacher's ability to practice through many ways. As the saying goes, "It takes a good blacksmith to make steel." We must improve the quality of production internships and guide teachers to play a key role. At present, young teachers in this field all have doctoral degrees, and some teachers still have a high level of academic experience in studying abroad. However, these young teachers come from schools and have no experience in engineering practice. To this end, we have adopted the following measures. According to the principle of "old, young, middle-aged", we have selected teachers with rich experience in engineering practice to lead young teachers to form a relatively stable team of production practice teachers. Teaching young teachers to help improve the team's practical teaching ability and guidance level, enhance young teachers' engineering awareness and improve their ability to work. Encourage teachers to actively cooperate with enterprises in scientific research. Young teachers go to the company to do post-doctoral research and enhance engineering practice capabilities, so that they have more opportunities to in-depth production lines and improve their practical ability. Our school requires young teachers to enter the laboratory, learn from the lab teachers, and be familiar with laboratory equipment and teaching to enhance practical ability. In view of the shortage of production teaching materials and weak pertinence, on the one hand, we actively collaborate with the technical staff of the internship units to prepare teaching materials. On the other hand, some internal training materials are selected as production internship materials, which are not only highly targeted, but also can be updated in real time. If we want to fundamentally solve this problem, we must improve teachers' practical ability. With the enhancement of teachers' practical ability, writing excellent internship teaching materials can only be achieved.

4) Optimize the structure of teachers and strengthen the strength of practical teaching. In order to better achieve the goal of excellence in talent training for metal engineering majors in our school, our institute has further optimized the practical teaching team, introduced the teachers of the theory class into practice teaching, strengthened the strength of the practical teaching team, and a practical teaching team consisting of a backbone teacher with a metal material background as the main member was established. On the basis of guaranteeing the smooth operation of the school-enterprise practice base, we will adopt complementary methods of school and enterprise to complete the task

of practical teaching and improve students' practical ability and practical ability. On the one hand, the Academy regularly and systematically assigns young teachers to practice outside the school base and the first line of production. It is familiar with the process flow, technical equipment, and production management experience of the company's production lines. Collect relevant data of the production process to improve the overall quality of teachers' "teaching" and "use." On the other hand, we employ highly qualified and experienced corporate engineers to teach students part-time, introduce the company's production practices and management experience to students, and regularly communicate with metal materials engineering teachers.

## 5. Evaluation Model of Practice Teaching Effect of Metal Material Engineering Specialty

This paper mainly studies the practice teaching of metal material engineering, aiming at cultivating the spirit of innovation and entrepreneurship, through the practice teaching reform of metal material engineering, adhere to the practice teaching, strengthen the practice teaching, improve the practice teaching system, reform the practice teaching content, and effectively improve the effectiveness of practice teaching. In order to understand the effectiveness of practical teaching, this paper uses fuzzy comprehensive evaluation method to evaluate the teaching effect. In this paper, the relationship between the practical teaching of metal material engineering and the fuzzy comprehensive evaluation model is established, the weight set C of evaluation factors is determined as follows:

$$\sum_{i=1}^k c = 1, c = \sum_{j=1}^{n_i} c_{ij} \quad (1)$$

The fuzzy relation matrix R between evaluation indexes and comments is established, the matrix is as follows:

$$R = \begin{bmatrix} r_{11} & r_{12} & \bullet & r_{1p} \\ r_{21} & r_{22} & \bullet & r_{2p} \\ \bullet & \bullet & \bullet & \bullet \\ r_{q1} & r_{q2} & \bullet & r_{qp} \end{bmatrix} \quad (2)$$

According to the scenario index weight C and the relationship matrix R, the final evaluation value B can be calculated, as shown in the formula:

$$B = C * R = C * \begin{bmatrix} r_{11} & r_{12} & \bullet & r_{1p} \\ r_{21} & r_{22} & \bullet & r_{2p} \\ \bullet & \bullet & \bullet & \bullet \\ r_{q1} & r_{q2} & \bullet & r_{qp} \end{bmatrix} = (b_1, b_2, \bullet, b_p) \quad (3)$$

The final evaluation value is the evaluation grade of teaching effect.

## 6. Research and Analysis on Practical Teaching of Metal Material Engineering

### 6.1. Analysis on Practical Teaching of Metal Material Engineering

With the development of China's economy and the adjustment of industrial structure, especially

the adjustment of higher education major structure and the expansion of enrollment scale, colleges and universities have also made corresponding adjustments to the teaching content and training plan, and the traditional production practice methods have also been greatly impacted. There are many problems in the practice of metal material engineering, In this paper, through investigation and research to understand the problems of metal materials engineering practice, the results are shown in Table 1.

Table 1. Analysis on practical teaching of metal material engineering

	Major structure adjustment and enrollment expansion	Inconvenient practice	Inexperienced teachers	Lack of relevant teaching materials	other
proportion	76.31	92.58	86.53	84.92	31.27

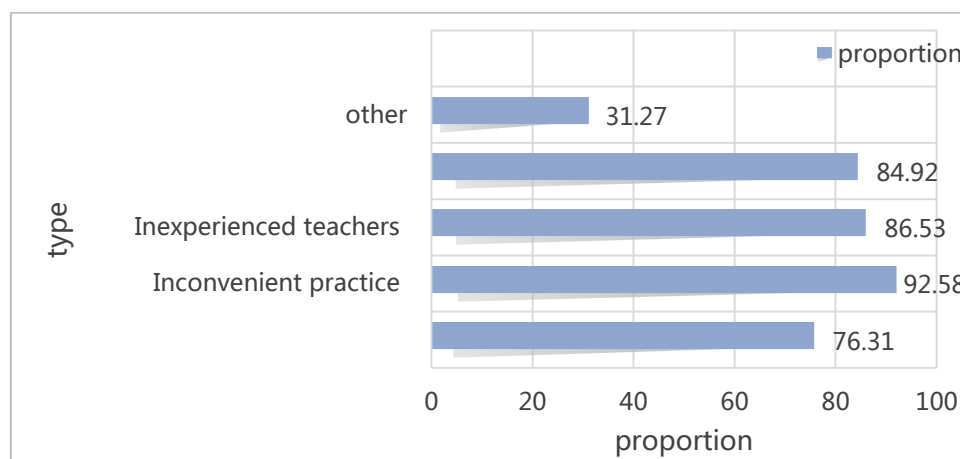
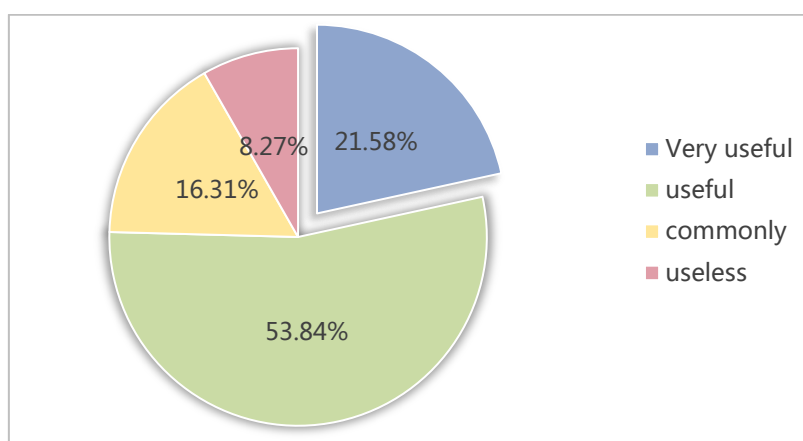


Figure 1. Analysis on practical teaching of metal material engineering

It can be seen from Figure 1 that the main problems in the practical practice of metal material engineering are the adjustment and expansion of professional structure, inconvenience of practical practice, lack of experience of teachers and lack of relevant teaching materials. In this paper, according to the existing problems, after many investigations and detailed discussions, combined with the characteristics of metal material engineering, the reform measures are put forward.

## 6.2. Analysis of Practice Teaching Attitude of Metal Material Engineering Students

In this paper, through the construction and improvement of the practical teaching system, enrich the practical teaching content, reform the practical teaching methods, broaden students' practical learning vision, improve the effectiveness and interest of practical learning, and finally realize the education of cultivating and improving college students' innovation and entrepreneurship ability. In this paper, through the form of questionnaire survey to collect and sort out the practice teaching attitude of metal materials engineering students, the data results are shown in Figure 2.



*Figure 2. Analysis of practice teaching attitude of metal material engineering students*

As can be seen from Figure 2, in the attitude of metal materials engineering students towards practice teaching, 75.42% of the students think that practice teaching is useful, which can improve the practical ability and analysis ability of solving problems, 16.31% of the students think that the practice teaching reform is general, and 8.27% of the students think that the practice teaching reform is useless.

## 6. Summary

Emphasis on practical teaching, we must completely change the concept of subordination of practice attached to the theory of teaching. we must establish the practice of theoretical teaching has the icing on the cake. Every practical link in practical teaching contains the cultivation of innovation and entrepreneurship. This requires practical teaching teachers to adopt appropriate teaching methods and means to achieve the goal of cultivating students' ability for innovation and entrepreneurship. Through the research on the practical teaching reform of metal materials engineering, this article has achieved effective improvement of practical teaching results, improved the students' practical hands-on and analytical ability to solve problems, and finally achieved the cultivation of students' innovative and entrepreneurial abilities.

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## Data Availability

Data sharing is not applicable to this article as no new data were created or analysed in this study.

## Conflict of Interest

The author states that this article has no conflict of interest.

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