

# The Application of Digital Teaching Resources in the Construction of Engineering Training Teaching Materials

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**Abstract:** *The paper analyzes the common problems of engineering training teaching materials, and puts forward to solve the existing problems from four aspects: building a three-dimensional teaching material system, updating the content of teaching materials with the times, providing digital teaching resources and using AR technology to extend teaching materials. The construction of engineering training materials that meet the requirements can lay a solid foundation for engineering training.*

**Keywords:** *AR Technology; Practical Teaching; Engineering Training Materials; Teaching Reform; Digital Resources*

## 1. Introduction

Engineering training is an indispensable part of engineering practice teaching. It is of great significance to cultivate students' innovative spirit, engineering consciousness and strong practical ability. [1] Under the background of actively promoting the "Construction of New Engineering Courses" by the ministry of education, universities have increased investment in engineering training. However, some universities pay too much attention to the construction of hardware and ignore the construction of relevant supporting teaching materials, resulting in a bottleneck in their construction.

Engineering training materials that are an indispensable part of teachers' teaching and students' learning are compiled according to curriculum standards and syllabus. The characteristics of engineering training teaching materials are different from general disciplinary teaching materials. In the process of teaching materials construction, it needs to emphasize scientificity, foresight, operability, technology and systematicness. [2][3]

## 2. The Problems in Engineering Training Teaching Materials

Most engineering training courses are developed from the original metalworking practice courses. At present, many engineering training centers do not have teaching materials or still use the teaching materials of early metalworking practice. There are some problems in the existing engineering training teaching materials.

### 2.1 The Unclear Positioning of Teaching Materials

Because of its own characteristics, engineering training has different requirements for teaching materials from general courses. General teaching materials require a systematic introduction to the research objects, tasks and methods of the subject, the basic concepts, theories and their sources or the derivation of formulas and theorems, and the applied theories or applied technologies, etc. However, the requirements of engineering training materials are as follows: concise theory, integration of many relevant discipline knowledge, practice and application content, operability, foresight and comprehensiveness, and large engineering background. However, some of the current engineering training teaching materials often have profound and lengthy theoretical analysis and derivation calculus, which is contrary to the principle of engineering training itself, which is light on theory and heavy on practice. How to find the correct positioning according to their own characteristics is an urgent problem to be solved in many engineering training teaching materials.

## ***2.2 The Outdated content of Teaching Materials***

With the progress of science and technology, new technologies and new processes are constantly put into industrial production. However, the teaching materials of engineering training generally lag behind. At present, the equipment and technology involved in most engineering training teaching materials are far behind the equipment and technology used in enterprise production. Most of the teaching materials are still shackled by the traditional metalworking and electrical training. The content of teaching materials is still dominated by traditional processes such as turning, pliers, milling, planing, grinding, casting, forging and welding, with a few new technologies added. There are few cutting-edge technologies. [4] [5]

## ***2.3 Lack of Systematicness and Comprehensiveness***

At present, most engineering training still focuses on modular teaching, and the teaching materials still focus on cultivating students' basic skills and acquiring necessary process knowledge. However, its design content does not fully consider the close combination of professional knowledge and engineering practice, lacks practical and innovative projects and engineering cases, and completely does not reflect the great engineering view.

Taking the engineering training center of A university as an example, the center offers 23 teaching modules and provides teaching materials. However, each module is independent of each other in the teaching process. The same is true of the teaching materials. As a result, students are at a loss in the face of practical problems in design and fabrication after practical training. This is contrary to the original intention of engineering training.

## ***2.4 Insufficient Expressive Force***

Because engineering training involves many fields and disciplines, it has its own special curriculum characteristics, and often involves the structural display of some complex equipment and some processing processes that are inconvenient to observe, etc. In short, simple text narration and simple drawings can not better show the three-dimensional and dynamic content.

Influenced by the layout and printing of teaching materials, it is often necessary to illustrate the problem with as few drawings as possible. This requires students to have high professional foundation and imagination. This increases the difficulty of students' learning, makes students have little interest in reading teaching materials, feels boring in reading, and then has a resistance to the learning of engineering training.

## **3. The Causes of Problems in Engineering Training Teaching Materials**

### ***3.1 Insufficient Attention is paid to Engineering Training Teaching Materials***

The engineering training centers of most universities in China are transformed from the original school-run practice factories. Accordingly, the quality of engineering training instructors is uneven and the teaching method is single. The historical origin of the engineering training center has caused a certain degree of path dependence on the current engineering training teaching mode, that is, the traditional engineering training "teacher leads apprentice" teaching mode of "speaking-doing", which simply emphasizes practical operation. Many engineering training centers do not pay attention to the construction of engineering training teaching materials and think that teaching materials in engineering training are dispensable, which is extremely incorrect.

### ***3.2 The Limited Level of Teaching Materials Writers***

The writers of engineering training teaching materials can generally be divided into two categories: teachers of related majors, and the personnel of engineering training center in university. When professional teachers write teaching materials, due to the lack of practical training in production and lack of engineering practical experience, it is difficult to connect with engineering practice, so that the compiled teaching materials can not fit the actual teaching. However, experienced teaching instructors are often the original technical workers in the school-run factory. They have strong practical ability and can complete daily teaching guidance, their cultural level is generally low and they are unable to write

teaching materials. Although the young guidance personnel newly entering engineering training generally have master's degree or above, they lack engineering practice ability because they are directly from school to school.

### ***3.3 Reasons for Backward Concept***

In 2018, "The Action Plan for Educational Informatization 2.0" issued by the ministry of education proposed to continuously promote the deep integration of information technology and education, promote the high-level evolution of educational informatization from integrated application to innovative development, deeply integrate information technology and intelligent technology into the whole process of education, and promote the improvement of teaching, management and performance.<sup>[6]</sup> However, many writers' ideas of teaching materials are relatively backward and still stay in the original form of paper teaching materials. The simple paper teaching materials can not meet the needs of teaching and learning.

## **4. Introduce Digital Teaching Resources into Engineering Training Teaching Materials system**

### ***4.1 Building a Three-Dimensional Teaching Material System***

Due to the characteristics of the course, the complete teaching materials system of engineering training should include three parts: first, the engineering training textbook, based on the basic concepts, has carried out appropriate integration planning on the basis of the traditional practice content, enriched the relevant contents of new technology and new process, and introduced the theoretical knowledge involved in relevant modules in depth. Second, the engineering training instruction, which describes the specific operation of the equipment required in the training in detail according to the characteristics of each module, so as to make the students clear about the whole training operation process. Third, the engineering training practice report, which reviews and summarizes the relevant contents of engineering training, and strengthens the understanding of the knowledge points of the course examination.

### ***4.2 Updating the Content of Teaching Materials with the Times***

Before writing teaching materials, we should fully investigate and follow the pulse of the times and the development of market economy. When new processes, new requirements and new specifications appear, engineering training teaching materials need to be updated in real time. On the basis of traditional metalworking projects, the current cutting-edge 3D printing, robotics, artificial intelligence, intelligent manufacturing and other related contents should be introduced into engineering training teaching materials. In short, due to the rapid progress of science and technology, engineering training teaching materials should be updated and supplemented regularly. [7]

### ***4.3 Providing Digital Teaching Resources***

It is very important to support digital teaching resources. Specifically: for knowledge points such as principle explanation and process display, two-dimensional plane animation can be configured; for the structural display class, the knowledge points that require high structural authenticity and three-dimensional sense and emphasize spatial three-dimensional structure can be configured with three-dimensional animation resources; for knowledge points that require strong authenticity of scenes and knowledge carriers, video resources recorded on site can be configured.

For some knowledge points that require students to master the logical order of structure, simple two-dimensional plane animation, three-dimensional plane animation and live video recording are insufficient. For example, in the mold training, students are required to carry out the operation training of stamping mold assembly and disassembly and stamping molding skills, as well as the operation training of injection mold assembly and disassembly and injection molding. Because students do not fully understand the transmission form, connection mode and fixing mode, disassembly and assembly tools, they often carry out barbaric operation and cause teaching paradoxes of high risk, high cost and low quality. If the mold virtual simulation software is used to combine virtual simulation with real operation, the overall quality of engineering training will be greatly improved. [8][9]

#### **4.4 Using AR Technology to Extend Teaching Materials**

It is very important to use AR technology to support digital teaching resources and extend teaching materials system. The engineering training site is the place for students to carry out training and learning. Its design and layout often simulate the production environment as real as possible. A new wall chart system of engineering training teaching site is established by using AR technology. Students can use the corresponding teaching resources at any time to express and explain some knowledge points and operation difficulties with the help of AR technology. In case of doubt, students can not only seek help from teachers, but also scan codes by themselves. It solves the problem of limited space of teaching materials and is a supplement and extension of teaching materials.

#### **5. Conclusions**

Under the background of actively promoting the “Construction of New Engineering Courses” by the ministry of education, the requirements for practical teaching are increasing, and the construction of engineering training is deepening. The construction of new engineering training teaching materials has become an important help to break the limitations of the traditional practical teaching mode of engineering education. This paper solves the existing problems from four aspects: building a three-dimensional teaching material system, updating the content of teaching materials with the times, providing digital teaching resources and using AR technology to extend teaching materials.<sup>[10]</sup>

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