



# Reform and Practice of Digital Teaching of Engineering Mechanics Course Under the Background of “Double High Program”

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**Abstract.** At present, higher vocational education is in a very important period of change, especially the “Double High Program” launched in 2019. Combining with our own reality, we should promote the curriculum construction around the goals, tasks and requirements of the “Double High Plan”. Digital curriculum is an important content of teaching construction in various colleges and universities at present. And it is the foundation of education and teaching informationization. Taking the course of engineering mechanics as an example, the construction of digital course is carried out. In most engineering majors, such as mechanical engineering, engineering mechanics is an important professional basic course, which is a bridge from basic course to professional course. Engineering mechanics course is characterized by many concepts, many theorems, many formulas, many calculations, strong theory, etc., the course is difficult, backward teaching methods and insufficient experimental equipment. In this Paper, digital construction of engineering mechanics course from the following aspects: build a virtual simulation practice teaching platform, the establishment of digital teaching re-sources, choose a suitable e-learning platform, scientific research work of data statistics. It has been proved by practice that compared with traditional teaching classes, the teaching effect of students’ learning enthusiasm and academic achievements has been significantly improved.

**Keywords:** Higher vocational education · “Double High Plan” · Engineering mechanics · Digital course

## 1 The Importance of Constructing Digital Curriculum

After the promulgation of the National Vocational Education Reform Implementation Plan in January, 2019, the Ministry of Education and the Ministry of Finance promptly launched the high-level vocational schools with Chinese characteristics and professional construction plan (referred to as the “Double High Plan”), which placed higher vocational education in a more prominent position in building a modern vocational education system and promoting educational reform and innovation, and entrusted higher vocational schools with the historical responsibility of deepening educational reform, exploring

the laws of type education and promoting the high-quality development of vocational education. The “Double-high Plan” puts forward the standard requirements of “Chinese characteristics and world level”, shows the expected goal of “significantly improving school-running level, service ability and international influence”, plans the construction path of “one strengthening, four building and five upgrading”, and depicts the blueprint for the development of higher vocational education in China [1]. At present, under the guidance of Xi Jinping’s thought of socialism with Chinese characteristics, our school is studying in depth the important deployment of vocational education reform in China, combining with its own reality, and doing a good job in the construction of our school around the goals, tasks and requirements of the “Double High Plan”. In the process of work, we deeply realize that the “double high plan” is a great opportunity to promote the construction of school curriculum.

With the advent of the “digital” era, great changes are taking place in students’ learning methods, and the integration of information technology and education and teaching has become an inevitable choice for educational informatization. The digital curriculum draws lessons from the open educational concept and uses the support of information infrastructure to digitally process and produce various professional teaching resources for learners to learn. Digital curriculum can create an environment of “autonomy”, “intersection”, “universality” and “immediacy”, and improve learning efficiency through new learning methods, which has important guiding significance for students in higher vocational colleges.

## **2 The Present Situation and Existing Problems of Engineering Mechanics Teaching**

### **2.1 The Course Is Difficult**

Engineering mechanics is a technical core basic course with strong theory and close connection with practical engineering application. Its theorems, laws and conclusions are widely used in engineering technology of all walks of life, which is an important basis for solving practical engineering problems. This course has many abstract theoretical knowledge points and limited teaching hours, resulting in unsatisfactory teaching effect. In addition, the contents of the teaching materials are not updated in time, lacking social practicability and professional pertinence, which virtually increases the difficulty of the course.

### **2.2 Students Have Poor Foundation and Low Enthusiasm for Learning**

Engineering mechanics course is characterized by many concepts, many theorems, many formulas, many calculations, strong theory, etc. In addition, students in higher vocational colleges have weak foundation in mathematical physics, most of them have no good study habits, lack confidence and enthusiasm in learning, and most of them have weak imagination and sense of space, which makes it difficult to understand the structural stress state and stress distribution in “engineering mechanics”. In the course teaching, there are few engineering cases, so students lack motivation and enthusiasm for the course of engineering mechanics, which makes engineering mechanics one of the courses with high make-up and re-examination rate every semester.

### 2.3 Backward Teaching Methods and Insufficient Experimental Equipment

In most engineering majors, such as mechanical engineering, engineering mechanics is an important professional basic course, which is a bridge from basic course to professional course. The practical teaching of engineering mechanics can deepen students' understanding of the movement law of components and their understanding of material properties and engineering safety. Practical teaching is an important organic part of the curriculum. For a long time, the experimental module of engineering mechanics has been a difficult point in vocational college teaching. The related experimental equipment has many capital investment, large area, high experimental cost and danger. Students are generally not interested in experimental teaching, and the teaching quality is poor.

## 3 Digital Construction of Engineering Mechanics Course from the Following Aspects

### 3.1 Build a Virtual Simulation Practice Teaching Platform

Practical teaching is an important organic part of the curriculum. Developing digital courses in the form of virtual simulation is the future development direction, which can reduce school capital investment, effectively avoid safety accidents and improve students' learning enthusiasm.

Taking the classical mechanics experimental teaching in engineering mechanics course as the research subject, our school develops digital software, and carries out tensile, compression, bending and torsion tests on metal samples of various materials to obtain rich experimental data, and records the video of the experimental process at the experimental site, taking pictures before and after the experiment; Combined with experimental data, set mathematical model and running program, and develop digital



Fig. 1. Virtual simulation practice.

teaching software. The virtual simulation technology is applied to the practical teaching of engineering mechanics. The virtual simulation practice process of students (see Fig. 1).

In the process of virtual simulation, students can freely choose the speed of experimental animation on the experimental platform, pause the stretching process at any time and observe the force deformation curve; Secondly, students can also choose different loading speeds and loading methods to observe the performance changes of specimens under different stress environments; Finally, with the support of a large number of experimental data samples in the database, students can observe the deformation process and damage of specimens of various materials and shapes in the limited teaching hours, which greatly improves the learning effect. It can be seen that after the application of virtual simulation technology in practical teaching, the teaching process can be liberated from the traditional fixed experimental process, and students can get more operation direction, background knowledge, trial and error space and detailed data through the virtual simulation experimental platform [2].

### 3.2 The Establishment of Digital Teaching Resources

Digital teaching requires students to learn actively through the Internet, provided that the teaching resources are rich enough. The construction of digital teaching resource database is an important work for the success of digital teaching. Based on the existing teaching resources, the course teaching resource base integrates, expands and improves excellent teaching resources, and provides a platform for teachers and students to acquire knowledge and train. Specifically, teaching resources mainly include: media materials, test questions, test papers, courseware, study cases, course contents, experimental instructions, teaching videos, course development, literature materials, answers to common questions, resource directory index and online courses.

The teaching materials include mainly includes micro-lesson videos, teaching courseware, teaching plans, pictures, animations, simulations, curriculum standards, exercises and tests, test question banks and so on. The microlesson video of engineering mechanics course is fragmented, and a micro-lesson video is made for a knowledge point. The video duration is generally 5–10 min, which can ensure that students have patience to watch the complete video and complete the knowledge point before students become bored. Learning; The design of exercises and test questions is to ensure that students can study purposefully and with tasks in digital learning, and guide and help students to understand and master relevant knowledge. In a word, the construction of digital teaching resource library is a task with a heavy workload in the digital teaching reform of engineering mechanics course, and it is also a necessary condition that must be established before carrying out digital teaching. The establishment of digital teaching resource library is not static. With the changes of curriculum standards and technological development, the resources of teaching resource library should be updated and supplemented at any time.

### 3.3 Choose a Suitable Elearning Platform

Adopt the teaching platform-Superstar Learning Communication. This learning platform is based on a mobile App developed by Superstar Company, which integrates resources, courses, learning, evaluation and interaction. Based on the deep integration of informationization and teaching, it is a mobile online teaching platform for mobile terminals (smart phones or tablet computers), and the mobile phone and computer terminals of the online teaching platform of Engineering Mechanics are established. On the computer side of Superstar Learning, teachers create courses, publish tasks and organize teaching activities on the platform; Students actively respond to and complete the tasks issued by teachers on the mobile side, and interact with teachers anytime and anywhere. At the same time, teachers can check students' learning situation in real time according to the statistical data of the platform, and adjust the offline teaching content in time according to the online learning situation of students. This mixed teaching method has realized many teaching ideas and effects that traditional teaching can't achieve at all, and provided students with a brand-new autonomous learning model [3].

### 3.4 Scientific Research Work of Data Statistics

Compared with traditional teaching, digital teaching software can provide a large amount of data, and the statistics and research of these data can better feedback and optimize classroom education, improve teaching quality and students' participation, and form a closed-loop teaching. Based on the field experimental data, software programs, students' experimental data and so on, a digital teaching mathematical model is established. Furthermore, the A/B teaching scheme is adopted to optimize the teaching mathematical model from the aspects of teaching time allocation, students' participation and examination results. The digital teaching mathematical model developed in this course is universal and provides theoretical support for the digital construction of other courses shows the statistical work (see Fig. 2).

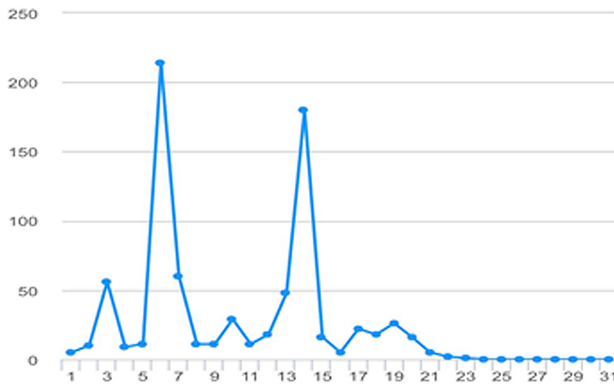


Fig. 2. Work of data statistics.

## **4 Advantages of Digital Teaching Course Development of Engineering Mechanics Course**

### **4.1 Innovative Teaching Mode and Concept of Engineering Mechanics Course**

At present, the teaching of engineering mechanics still adopts the traditional classroom teaching mode, and the teaching materials are only in the form of teaching materials and courseware, so the teaching effect is seriously limited. Developing the digital course of engineering mechanics based on virtual simulation technology is a great innovation to the existing conventional teaching mode and concept, an important step and inevitable choice for the scientific, informational and digital teaching mode of engineering mechanics course, and also a step exploration for the construction of “double high program”.

### **4.2 Significant Savings in Teaching Costs**

In the standard engineering mechanics course, the basic mechanics experiment teaching link is essential, and it is an essential link to cultivate students’ practical ability and help students understand the course. However, the cost of purchasing and maintaining experimental equipment and consumables is very high. If we only spend a lot of money to purchase experimental equipment and materials for this course, the cost is huge and the utilization rate is low. This problem can be effectively solved by building a digital course of virtual simulation. Students can learn and simulate the mechanical experiment process through simulation software, which not only avoids the lack of experimental links, but also saves a lot of hardware costs.

### **4.3 Avoid Potential Safety Hazards**

In recent years, school laboratory safety accidents have occurred frequently, causing irreparable losses to both schools and students’ families. There are certain dangers in related experiments in engineering mechanics course, and even strict management measures can only minimize potential safety hazards, which cannot be completely eliminated. Through the research and construction of digital courses in the form of virtual simulation, the problem of potential safety hazards can be perfectly solved, and students can complete the experimental learning process in a safe and controlled computer environment, thus ensuring zero risk in experimental teaching of engineering mechanics courses to the greatest extent.

### **4.4 Contribute to Professional Construction and Talent Training of Teachers**

At present, virtual simulation technology has been widely recognized by the society, and the promotion and application of virtual simulation technology are also actively promoted at the national level. Virtual simulation course construction is being carried out in all colleges and universities. Our school is one of 10 tier-A colleges and universities listed in the List of Construction Units of High-level Higher Vocational Schools and Specialty Construction Plans with Chinese Characteristics published by the Ministry of Education and the Ministry of Finance. Among them, the automobile manufacturing and

assembly technology major is the key professional group, and will focus on supporting the first development in the next five years. Engineering mechanics course is an important professional basic course in the new talent training program of automobile manufacturing and assembly major, and the construction of engineering mechanics course should keep pace with the times. Through the construction of digital course module, virtual simulation technology and digital technology can effectively help the development and progress of engineering mechanics courses. At the same time, in the process of digital curriculum module construction, through the development of relevant research work, it can also train a group of teachers who master virtual simulation technology and digital technology for schools, and lay a talent foundation for the subsequent “double high program” construction and future curriculum construction.

## 5 Conclusion

To sum up, college education follows the development trend of digital curriculum, and the concepts of changing roles, free learning and instant learning are gradually becoming the core concepts of talent training in new colleges and universities in the 21st century. Under the impetus of “double high” construction, the digital course construction of engineering mechanics is carried out. By constructing the digital course of virtual simulation, the problems of students’ learning difficulty, high school input cost and potential safety hazards in practice can be effectively solved. Students can learn and simulate the mechanical experiment process through simulation software, which not only avoids the lack of experimental links, but also saves a lot of hardware costs. Give full play to the advantages of a series of teaching allocation such as advanced teaching resources, teaching concepts and service facilities, and provide students with a broader learning space and meet the needs of socialized learning; Students are encouraged to keep pace with the times, change their methods and study independently, so as to cultivate new talents with high qualification, high quality and high technology to meet the requirements of future social development.

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