

# Focusing on Ability Training of 3D Measuring and Modeling Experiment Teaching Reformation for Engineering Equipment

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## ABSTRACT

In the light of 3D measuring and modeling experiment teaching reformation for engineering equipment in our school, this paper puts forward that the experimental teaching reform needs to project quality and skill training as the foundation, combined with the characteristic of use and maintenance of engineering equipment, broaden the cognitive system. This paper further expounds the reform mode of strengthening the training of engineering design and analysis ability aiming at improving the ability of analyzing problems, and points out the ways to improve the students' ability of engineering innovation. The main purpose is to ensure the quality of experimental teaching and improve students' comprehensive ability and quality.

**Keywords:** *Experiment teaching reformation, Ability training, Engineering innovation ability, 3D measuring and modeling.*

## 1. INTRODUCTION

At present, many colleges and universities have offered 3D measuring and modeling, reverse engineering and other theoretical and experimental courses. But military academy in undergraduate experimental teaching still exists some problems that cannot be ignored, which requires the experimental teaching system of military academy education must keep up with the pace of the development of higher education. For establishing a new comprehensive experimental teaching system to meet the needs of army personnel training, it should carefully analyze the current situation and characteristic of experimental teaching, and carry on the beneficial exploration and attempt to reform. This is the key to the construction of innovative experimental system in military academies at present, and also the neglect or insufficient attention in the construction of experimental reform in military comprehensive universities. Therefore, the research group actively explored how to establish the experimental teaching system of 3D measuring and modeling, carry out novel and effective experimental teaching, highlight the training of scientific thinking methods, focus on training students' engineering quality

and practical innovation ability, and ensure the quality of experimental teaching.

## 2. THE EXPERIMENTAL TEACHING REFORM BASED ON TRAINING OF ENGINEERING QUALITY AND SKILLS

Under the information condition, the primary training of primary command talent is to enable the students to master several tools in the field, which is the principle of "to do a good job, one must first sharpen his tools". In the primary command and technical officer training of mechanical engineering, engineering equipment maintenance and management, road and bridge and river crossing engineering, engineering graphics serve as the main medium for the definition, expression and transmission of engineering and product information in conception, design and manufacturing.

3D measuring and modeling technology is a hot research topic, which is to dissect, deepen and recreate existing products. One of the key equipment of 3D measuring is 3D laser scanner. The data obtained from 3D measuring is the basis of 3D modeling, which is the basis of developing virtual training, structural chart, and dynamic simulation calculation.

3D measuring, 3D modeling and CAD, etc. are closely combined with classroom theoretical teaching and practice, and a good practice platform is established for students of these majors to train students' engineering design and computer application ability. Students by learning to master relevant graphic tools software, process calculation software, and used in the mechanical design of engineering drawing tool commonly used from two-dimensional engineering drawing to 3D modeling, training students' ability of engaged in the design of the basic expression and engineering drawing ability, make students have engineering quality and the rigorous work style.

**3. BROADEN THE COGNITIVE SYSTEM BY COMBINING THE USE AND MAINTENANCE CHARACTERISTICS OF ENGINEERING EQUIPMENT**

The study and understanding of the form, composition, structure, mechanism and working principle of mechanical design objects must be carried out through actual models, parts, devices and machines. The cognitive system implements the principle of combining the virtual with the real and constitutes a three-dimensional cognitive structure system.

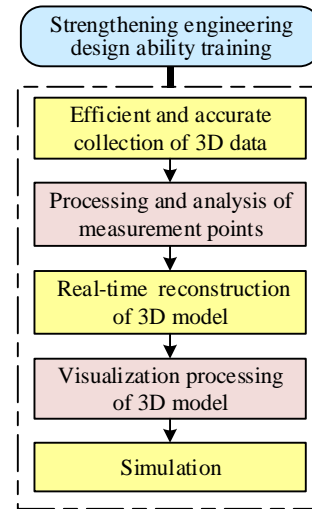
On the basis of the original showrooms of common mechanical parts and common institutions, the mechanical form, composition, component structure and common mechanism principle cognition of the students of the series courses of mechanical design are firstly guaranteed. The cognitive environment of equipment based on engineering equipment is closely combined. Through visiting and learning, disassembling and assembling, measurement, modeling and demonstration, virtual simulation and other activities to stimulate students' active learning potential.

In addition, in the development and construction of engineering equipment virtual training software, training various institutions, systems, operation and maintenance of interactive cognitive experiments. Students can also use online resources for learning and awareness.

**4. STRENGTHENING THE ENGINEERING DESIGN ABILITY TRAINING WITH THE GOAL OF IMPROVING THE ABILITY TO ANALYZE PROBLEMS**

In order to cultivate students professional skills and the ability to find and solve problems and hands-on ability, the engineering equipment 3D measuring and modeling laboratory make the students' ability of engineering design develop and improve by the experimental teaching function of 3D data efficient collecting test, data processing, real-time 3D model

reconstruction, and 3D model visualization processing experiment, as shown in figure 1.



**Figure 1** The training means of strengthening engineering design ability.

**4.1. Efficient and Accurate Collection Experiment**

By analyze the working principles and structural characteristics of parts and mechanisms, students can master engineering analysis techniques, and deepen the understanding of the working principles of parts and mechanisms. Based on the complexity of equipment parts and components structure and the diversity of virtual maintenance precision requirements, an efficient and accurate collection experiment of engineering equipment is carried out. The hand-held 3D laser scanner is used for data collection. Through the laser ranging principle and the automatic control technology, the target object is scanned according to the preset resolution, which can quickly and continuously obtain the dense sampling point data on the surface of the target object, namely the point cloud data. To train students' practical ability of measurement, collection, data transmission and storage can lay a foundation for reconstruction of 3D model of typical equipment. The experiment can be combined with the schematic diagram measurement experiment, using actual equipment or typical mechanism model, through the schematic diagram measurement, object graphics abstract and abstract results, further analysis and use. In terms of machine structure, through the assembly and disassembly and analysis of a typical machine -- reducer, understand the reducer's working principle and composition and structure, establish the overall idea of mechanical structure design.

**4.2. Data Processing Experiment**

Through the data processing experiments, the cloud data processing and analysis of measurement points are carried out on typical equipment mechanisms. The collected original data processing includes noise removal, multi-view alignment, data simplification, splicing, segmentation and fitting, etc., so that the point cloud data can meet the requirements of the next step of data processing.

**4.3. 3D Model Reconstruction Experiment and Visualization Processing Experiment**

The real-time 3D model reconstruction experiments and visualization processing experiments perform re-processing and editing of the collected equipment model data, including modeling editing, structure editing, scale editing and texture editing, etc.

The collected data are imported into the virtual engine, and materials, textures and maps are added on the basis of geometric structure to realize the reconstruction of the 3D model.

**4.4. Simulation Experiment**

Using the virtual analysis experiment platform provided by some mechanism kinematics and dynamics analysis software, students can conduct structural analysis, kinematics and dynamics analysis on existing mechanism or new mechanism designed, and understand the movement characteristics and performance of mechanism. By using reverse engineering software and 3D modeling software, interference and assembly detection of mechanical structure are carried out to analyze the rationality of mechanical structure and structural assembly process.

The engineering design and problem analysis skills of students are trained through a variety of experiments and procedures. At the same time, the deepening and understanding of theoretical learning can be strengthened, which is conducive to consolidating course knowledge, improving engineering awareness and innovative thinking.

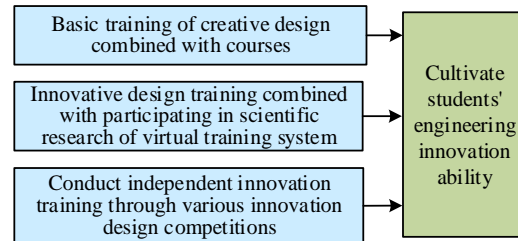
**5. TO CULTIVATE STUDENTS' ENGINEERING INNOVATION ABILITY THROUGH VARIOUS WAYS**

Innovation ability refers to the ability of a person (or a group) to obtain innovative results through innovative activities and behaviors. It is the most important, the highest level of a comprehensive ability. For military cadets, the ability to innovate is a universal ability in job hunting, development and career development.

Innovation ability embodies in all aspects, all the time, everywhere. Innovation ability in innovation

activities is mainly the combination of two kinds of ability, namely, raising problems and solving problems.

The cultivation of independent innovation ability is mainly reflected in the following aspects. The ways of cultivate students' engineering innovation ability is shown in figure 2.



**Figure 2** The ways of cultivate students' engineering innovation ability.

**5.1. Basic Training of Creative Design Combined with Courses**

Combined with the existing connecting rod mechanism innovation design experiment table, students according to their own design of institutional innovation program for physical lap, verify the rationality of the institution. Students carry out experiments independently, and their operational ability is further improved. Equipped with a comprehensive test bed for mechanical transmission, it provides five commonly used mechanical transmission modules. Students can combine creative ideas according to work requirements, and conduct the configuration and design of transmission modules by themselves. On the one hand, these experimental activities are to deepen the learning of course knowledge, improve the ability of hands-on assembly, understand the principles of assembly and positioning, and lay a foundation for innovative design.

**5.2. Innovative Design Training Combined with Participating in Scientific Research of Engineering Equipment Virtual Training System**

At present, the new virtual training system, and structural chart of engineering equipment are urgent to develop in the army. When students participate in some scientific research topics in engineering equipment measurement and 3D model reconstruction basic experiment, 3D model library, virtual system, and structural chart, they can study something in order to apply it, get a more systematic understanding and experience on the engineering equipment structure, and the maintenance means, also obtain the preliminary scientific research ability of exercise, in which is more important to be able to play to the subjective initiative, put forward new research ideas, have their own different

opinions or improvement methods of the scheme and process.

At the same time, some of these topics can be used as graduation project topics for undergraduate students, which can be chosen according to their own interests, so that students can get exercise in real scientific research work. The laboratory conditions can be used to promote students' graduation design, to provide students with some opportunities for practical operation, but also conducive to students to understand the latest technical development in the technical field, training students rigorous scientific attitude and serious, responsible, meticulous work spirit, mobilize their enthusiasm.

### ***5.3. Conduct Independent Innovation Training and Cultivate Engineering Innovation Ability through Various Innovation Design Competitions***

On the basis of students' practical teaching plan and the teaching situation of relevant laboratories, we provide a good service for students to participate in the innovation design competition, provide a big platform for innovation design, and carry out innovation training in the whole process according to the innovation project. Students spontaneously form a project team, find the topic with the theme, defend and demonstrate the scheme, determine the project scheme through discussion, carry out the specific design, some of the material production, installation and debugging, prepare the report document, and finally participate in the competition. The whole reflects the mode of carrying out research-based innovative personnel training.

## **6. CONCLUSIONS**

The authors combined with the cultivation core of big engineering consciousness, innovative consciousness and comprehensive ability of engineering practice, as well as the training purpose of high-quality, compound primary command personnel. This paper starts from the reform of the existing experimental teaching mode and system, and discusses the necessity and way of focusing on ability training of 3D measuring and modeling experiment teaching reformation for engineering equipment around the school personnel training goal.

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