

Research on the Application of Virtual Disassembly and Assembly Technology in the Teaching of Equipment Construction and Maintenance

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Abstract: Aiming at the problems of teaching risks, costs and effectiveness in the teaching of equipment construction and maintenance, based on the analysis of the advantages of virtual disassembly technology, the technical requirements of virtual disassembly and assembly teaching platform are constructed. It can be used as a reference for the construction of a virtual disassembly teaching platform for equipment construction and maintenance teaching, and it can help improve the training level of vocational and technical education skills.

Keywords: Practical Teaching; Virtual Disassembly; Teaching; Application.

1. Introduction

Vocational and Technical Education is job-oriented in the teaching process. Practical hours account for a considerable proportion. The reason is to greatly improve students' practical ability in school, to lay a solid foundation for future competent positions. At present, due to the limitation and restriction of teaching conditions, there is a certain contradiction between the improvement of school hours and practice level. It is still not enough to improve the quality of teaching by increasing the number of hours, and new teaching methods must be introduced to improve students' practical ability while saving resources, so as to improve the quality of teaching.

2. Problems Existing in Traditional Teaching of Equipment

The teaching of a large complex equipment is carried out according to the process of structure, workflow and maintenance. Among them, theoretical teaching focuses on explaining the basic principle, workflow, practical teaching pays attention to the basic process of maintenance and disassembly process, so as to train students' practical ability. At present, the traditional teaching method is adopted, the theory course is explained with courseware, and the equipment cognition is trained in physical equipment. The main process of practice class is based on what they have learned as the guidance, to dismantle, clean, test and assemble the equipment. This teaching method is simple and easy. However, restricted by the number of hours and equipment, there are mainly the following problems.

2.1. The Teaching Progress is Slow

With the deepening of school teaching reform, the work-oriented course is becoming more and more important, which greatly reduces the time and hours of the traditional course of structural principles. If we follow the original teaching process, we will generally spend a lot of time in the construction and principal course, the remaining time is not enough to support the subsequent practice process, resulting

in slow progress of teaching. In addition, the equipment is complex, has much more parts, in the process of disassembly and assembly, there are greater risks, and the space in the equipment is narrow, which is not convenient for multiple people to operate. Only 1-2 people can operate each time. The limited number of equipment, drag down the progress of teaching.

2.2. The High Cost of Teaching

Due to the lack of teaching aids, the actual equipment is used as the training equipment in the teaching process, its price is relatively expensive. According to the past teaching experience, in the theoretical courses, although the teacher has explained its main structure, working process, disassembly and installation process and assembly methods, in the specific practice process, due to the lack of practical assembly experience, improper use of tools or incorrect assembly methods, the equipment damage is relatively serious, resulting in the follow-up courses cannot be conducted normally, it also leads to a great waste of teaching resources. In addition, the lack of base equipment parts cannot make up the missing parts, which also affects the teaching and training. Therefore, When the whole teaching process is over, the teaching cost is high.

2.3. There are Risks in Teaching

The equipment is bulky, and the removal and installation of some parts need to rely on lifting appliances, In the past students have been injured by crushing and knocking. Improper operation of equipment also affects the intact rate of equipment, resulting in equipment loss and affecting the teaching progress.

2.4. Students are Slow to Understand in Theory Teaching

Students' slow understanding is due to the complexity of equipment on the one hand, and the teaching process currently adopts the teaching mode of courseware plus physical objects on the other hand. Courseware pictures and videos are not enough for students to quickly grasp the construction principle of equipment. However, it is a good way to adopt 3d

model. Due to the lack of relevant display platform and the insufficient understanding level of all students, how to properly use 3d model is an urgent problem to be solved.

2.5. Poor Teaching Effect

Due to the influence of students' understanding ability, the limitation of equipment quantity, the number of class hours, the size of class and other factors, the teaching effect is poor. For example, there must be a certain difference in the teaching effect between 30 and 10 people in a class

2.6. Lack of Equipment Affects Teaching Management

In the past teaching process, in order to fully guarantee the teaching progress, some students practiced and other students learned the theory, in order to make full use of the equipment, leading to a course student into several groups at the same time. On the one hand, increased the difficulty of management, on the other hand, in the process of equipment disassembly and assembly, some students do not understand the knowledge clearly, often remove by force, damage parts and components, which makes it difficult to recover the equipment. It's hard to guarantee the intact rate of equipment, thus making the next group of students unable to practice, greatly increasing the difficulty of teaching management.

2.7. Students' Self-learning Rate is Low

Under the current environment of vigorously advocating the teaching concept of " Learning-as-principal", this kind of teaching method, which only depends on teaching courseware, teaching materials and disassembly video, is difficult to guarantee students' self-study needs. in addition, limited by the number of teaching classes in time and place, students are unable to learn independently, the teaching idea of " Learning-as-principal " cannot be carried out in depth.

3. Virtual Disassembly Technology

With the continuous development of science and technology and the continuous accumulation of teaching resources, at present, this major has established a relatively rich 3d model resource database, but it cannot make full use of its value. In fact, the 3D model library is very useful for students to understand the structure and working principle of the equipment, However, restricted by the teaching conditions, most of the 3d models are used in the courseware making of course teaching in the form of plane screenshots, and the effect is not very good. It is only for the teaching by teachers, not for the learning by students.

3.1. Virtual Disassembly Technology

With the development of virtual reality technology, virtual disassembly technology has been widely used, especially in the component of mechanical parts, virtual disassembly as an important auxiliary means to understand the principle of mechanical structure, has been more and more attention [1]. Virtual disassembly technology makes use of virtual reality to achieve the goal of human-computer interaction. At the same time, by developing realistic disassembly scenes, users can immerse themselves in the virtual disassembly environment, and disassemble and install mechanical components or parts in the virtual scene without leaving home. Without mobilizing physical resources, trainers can operate on any personal computer, it can even realize the collaborative disassembly

and assembly based on network transmission. Obviously, the disassembly and assembly training in the virtual reality scene not only has the advantages of safety, economy, short training period and free from time, climate and site restrictions, but also is more realistic and effective than explaining the structural diagram and schematic diagram of the complex mechanism.

3.2. Requirements of Virtual Dismounting Teaching Platform

The virtual disassembly technology is applied to teaching practice, and generally a distributed platform is used for construction. Teachers and students are equipped with different modules, Teacher is responsible for the organization of teaching content, which mainly includes 3d model of equipment construction and working video animation, and process control of disassembly and installation. The training module includes automatic disassembly of the model, manual disassembly process with tools, so that students can actively explore the disassembly and installation process after watching the demonstration [2]. The assessment module assesses students' real skills and lays a solid foundation for their real operation. The details are as follows:

The platform includes knowledge base, management base, disassembly module and training and assessment module.

The Knowledge base includes:

Resource: basic knowledge of equipment, including equipment performance, composition, structure, workflow, disassembly technology, fault analysis judgment and exclusion. etc.

Form of resources: electronic teaching textbooks, videos, 3D model parts and assembly libraries, 3D animation, PPT, exercise materials, etc.

Resource combination: each knowledge point or case is used as an independent teaching unit to make, organize and manage teaching resources. It is especially suitable for flexible combination of various personalized teaching packages.

The management base includes:

Classify and manage the knowledge base, so that users can easily retrieve, view and use various teaching resources, including electronic documents, animation videos, PPT, exercise materials, etc. The electronic documentation contains various forms of resources necessary for the teaching of equipment construction principles and maintenance. Each type of resource is provided with text, CAD drawings and a large number of three-dimensional or physical pictures to explain.

Disassembly training module:

The whole process of equipment disassembly and assembly is automatically demonstrated with 3D animation, and the whole process is completely consistent with the workflow completed by the actual work position, The disassembly and assembly process can be single step, cycle, fast forward, backward and pause. It can freely change the Angle to view the disassembly process of each part, and each step is accompanied by a text description.

Students can disassemble and assemble each part of the equipment in 3D form on the computer. During the process, the virtual model can be rotated, scaled, transparent, sectioning and other observations to facilitate learning the construction.

In the process of disassembling and assembling, list all kinds of tools in the form of images, and ask the students to

select correctly, and give prompt or no action for wrong selection.

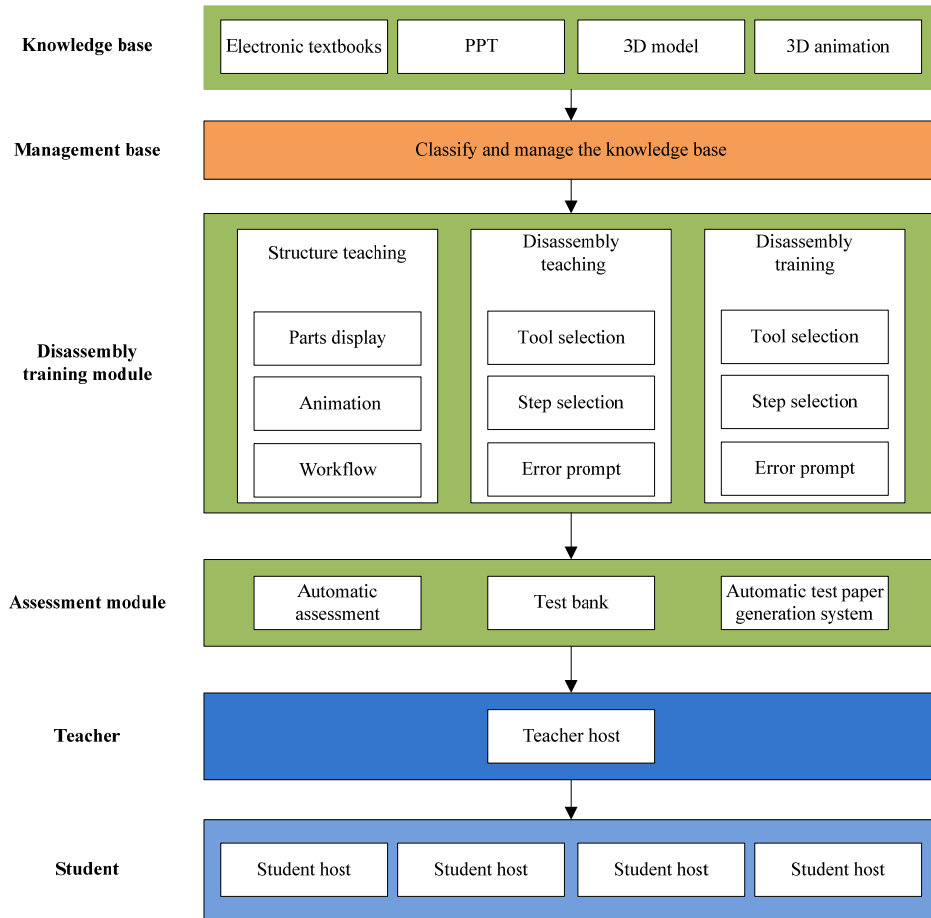


Fig 1. Virtual Disassembly and Assembly Platform Framework

It can automatically judge the correctness of the disassembly operation (including steps, tools, etc.), and give corresponding operation hints according to the selection when there are errors in the disassembly process.

In the process of disassembly and assembly, multiple paths can be selected without interference of parts, and common paths for post work requirements can be reserved at the same time. The purpose is to investigate the thinking ability of students in the process of disassembly and assembly.

Assessment module:

It mainly includes: automatic assessment of practical training, test bank, online automatic test paper generation system.

4. Advantages of Virtual Disassembly Teaching Platform in Equipment Construction and Maintenance Teaching

Virtual disassembly and assembly platform, using digital virtual simulation technology to create a visual simulation environment, replacing the real operation with the virtual model operation, in which the virtual disassembly and assembly process is the same as the actual training operation process. Operators can get the same experience as the real world, and the platform can also be used for the assessment of disassembly process. Since the platform integrates text, graphics and sound, has a friendly interface, and has changed the previous one-to-many teaching mode of teachers and students. In a virtual environment, on the basis of knowledge

and data sharing, students and teachers in one-to-one teaching situation can fully mobilize the enthusiasm of students and improve learning efficiency. Its main advantages include:

4.1. The Equipment Cost Has been Saved

The real equipment needed for training in the past is now designed by using virtual platform. The loss of the real equipment does not be considered. The quantity of equipment is not the key factor to be considered in teaching. Especially for the devices and equipment with high price, short quantity and vulnerable structure, the advantages are particularly obvious [3].

4.2. Conducive to the Scientific Progress of Teaching

The traditional teaching progress is held by the teachers in combination with the actual number of training equipment. It is very flexible, and the teaching progress varies from class to class, it is mainly restricted by various external factors. Using the virtual training platform, the one-to-one teaching process is adopted directly, without the interference of external factors, and the teaching progress is scientific and controllable. It is conducive to improving the learning effect.

4.3. It is Conducive to Students' Self-study and Improves Learning Efficiency.

In the past teaching process, students only have books in their hands. During the teaching process, the students mainly rely on listening under the stage, lacking enthusiasm and initiative. Using the virtual interactive teaching mode, on the one hand, students need to operate in learning. On the other

hand, 3D models and animations are more attractive to students than boring assembly drawings, which can greatly improve students' interest in learning. In addition, the virtual disassembling platform has a variety of resources available for students to self-study, it is no longer restricted by the lack of teaching resources.

4.4. Interactive Learning Truly Realizes the Teaching Concept of Learning-as-principal

In traditional teaching, teacher needs to face ten or even dozens of students at the same time. Restricted by the lack of external resources, teachers are satisfied with completing teaching tasks, students have no interest in learning, and classroom interaction is insufficient. Use virtual disassembling platform, "interaction" has become a key element of teaching, It must through the interaction between teachers and students to complete the task of teaching and learning, and the interaction is one-to-one pattern, stimulated the learning interest, promote the communication between teachers and students, students may be show his true idea in such an environment, realize the teaching idea of " Learning-as-principal ", It can promote the continuous improvement and enrichment of teaching process.

5. Problems Needing Attention

Virtual assembly and disassembly cannot completely

replace the real training of equipment. After the virtual disassembly and assembly teaching, students should also be using the actual equipment to further consolidate and test based on the knowledge. After graduation, the students are still facing the actual equipment, therefore the operation of equipment proficiency is still the goal of school teaching, which is also the ultimate goal of virtual disassembly teaching. In addition, no matter how to design the virtual assembly and disassembly system, there will still be a lack of independent thinking of students. This is the disadvantage of computer system, which should be avoided in teaching. Only by complementing the real training and the virtual disassembling training, can we achieve the goal of training qualified students.

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