

Application and Reform of Virtual Simulation Practice Teaching for Printing Engineering Major

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Abstract: Virtual simulation technology has been gradually applied in the practical teaching of printing engineering. This paper first explained the current situation and shortcomings of practical teaching in printing engineering, pointed out the advantages of virtual simulation practical teaching, then focused on the working principle and three characteristics of SHOTS printing simulation software, and briefly introduced the working mode and advantages of other virtual simulation systems such as offset printing line virtual simulation software, summarized their application in practice teaching, and finally gave three reform measures of virtual simulation practice teaching in printing engineering, and pointed out the development direction.

1. Introduction

In recent years, the rapid development of computer technology, network technology and information technology has not only made it an inevitable trend for virtual simulation technology to enter experimental teaching on a large scale, but also gave birth to virtual simulation practical teaching. It organically combines enterprise physical equipment with virtual teaching environment and gives full play to their strengths, thereby effectively enhances students' theoretical knowledge and practical skills. Currently, the printing industry is undergoing a technological revolution with digital and network technology as its core, and the industrial technology foundation is shifting from physical media to digital media and shifting from analog processes of digital processes. Modern printing industry in the digital age has shown the technical characteristics of digitization, information and intelligence. The simulation printing system, or virtual simulation experiment, developed by virtual simulation technology, is a real experimental environment simulated by 3D simulation technology, which allows students to experiment and practice in virtual 3D environment, collects data from experiments and training using information networked technology, and then conducts experimental curriculum arrangement and experimental effect investigation through virtual simulation experiment teaching management platform, combined with students' practical practice. It can provide a certain auxiliary role of students to operate the module of the printing press in the printing practice. This simulation system helps students understand the complete printing process and the structure and function of printing equipment. It also helps students master the control points of each control platform and the influence of the adjustment of printing process parameters on printing quality, and the analysis and resolution of actual printing production failures. Virtual simulation experiment teaching replaces "real" with "virtual". It can realize the teaching links where the actual experimental conditions are not available or the practical operation is difficult. This teaching method can not only save the cost of setting up experimental projects, but also has the characteristics of interaction, autonomy, expansibility and sharing [1]. It is an inevitable requirement for printing engineering teaching in the digital age.

2. The Status of Practical Teaching in Printing Engineering

The printing industry is a field with high professional, practical, and skill-based requirements. Employers hope that college graduates not only have a solid theoretical foundation, but also value students' engineering practice capabilities. Therefore, practical teaching is particularly important for undergraduate colleges that cultivate high-level applied talents. Practical teaching encourages students to combine theoretical knowledge with practical skills, solve practical problems, and accelerate technological innovation and product development. However, there are still many problems of practical teaching due to the influence of factors such as the development orientation of universities, teaching funds, and training venues.

Colleges and universities offering printing engineering majors lack "dual-professional" teachers. Although their professional teachers have rich theoretical knowledge, most of them do not have first-line work experience in enterprises and generally lack engineering practice capabilities, which makes it great to cultivate students' engineering awareness and practical skills difficult.

Printing and post-press processing equipment is complex and diverse, covering a large area. The purchase of experimental equipment with complete functions requires a large amount of capital. The requirements for hardware and maintenance sites are high. All these make it difficult for universities to continue to provide corresponding practical teaching funds and site to support. On the other hand ,There are a small number of teaching equipment, outdated models and simple functions. Compared with actual printing, the practical teaching environment and conditions have a large gap, which causes the school practical teaching to be out of touch with enterprise production [2].

The cost of practical teaching is high, and there are great security risks. Although some colleges and universities' printing engineering majors are equipped with advanced printing and post-press processing machinery, due to expensive equipment and insufficient number of sets, they cannot meet the needs of students for actual hands-on operation. As a result, relevant practical teaching is mainly based on teaching demonstrations. During the experiment, the cost of ink, plate, paper, and other consumables is relatively high, and the cost of practical teaching is relatively high, which makes part of the practical teaching a mere formality, and students cannot get effective training. The rapid operation of printing equipment not only brings hidden dangers to the personal safety of students, but also objectively poses environmental pollution problems.

3. The Superiority of Virtual Simulation Practice Teaching

Virtual simulation practice teaching uses virtual simulation technology, multimedia technology, network communication and human-computer interaction technology to simulate the actual occurrence of printing presses and printing failures in a full range of simulations. Students can perform skills training in the simulated role of the printer chief, and devote themselves to the actual "printing" environment, and their engineering practical skills will surely be improved.

The virtual simulation practice teaching content can be updated in a timely manner to the printing production equipment and scenes according to the development of new technologies, new formats, new models and new industries in the printing industry anytime and anywhere [3]. The practical teaching content is consistent with the actual printing production, which can make up for the shortcomings of the objective conditions of teaching to a large extent, and provide students with an approximately realistic teaching environment. Students can operate and train in a realistic training environment before entering the enterprise, and their ability to solve practical problems will be significantly improved.

In and out of the classroom, online and offline, students can operate the virtual simulation system at any time. It breaks the time and space limit of actual machine teaching. Students use continuous trial to master the actual operation and equipment failure analysis and resolution capabilities, without having to consider The teaching cost and equipment wastage cost caused by the actual wrong operation extend the time and space of practical teaching, to meet each student's printing production of different levels and different requirements of practical operation needs, and thus

improve the teaching quality and effectiveness of practical teaching.

In the virtual simulation teaching environment, computer screen simulation is used to replace traditional printing equipment, which avoids equipment damage and waste of consumables even personal injury that caused by unfamiliar processes or improper methods when students directly participate in printing production. It improves the safety of practical teaching. At the same time, teachers can check in time according to the students' problems of the actual simulation system, and timely feedback the students' latest learning dynamics, which is conducive to practical teaching case analysis^[4].

4. The Application of Virtual Simulation Teaching in the Practical Teaching of Printing Engineering

One of the practical teaching of virtual simulation in printing engineering is to choose SHOTS of Sinapse in France as the printing simulator (printing simulation software). The simulation software (system) is very powerful, and it simulates the German Man Roland 700 printing machine in the whole process or the latest Heidelberg printing machine (six-color printing + varnishing, as shown in Figure 1), which simulates and reproduces the faults and errors in the production of real printing machines in the form of software. The system builds the whole process of six-color printing and varnishing simulation from paper transfer, printing, paper collection, etc., including a series of modules such as plate, rubber cloth, ink, fountain solution, paper, etc., which can be observed in real time. Through this system, the operator can intuitively feel the printing press, as if operating a real printing press. The principle of the simulation system is to learn by making mistakes, but only in the simulation system rather than the printing press, therefore, its biggest feature is to allow students through constant trial and error to learn practical operation, fault analysis and troubleshooting, through the software can intuitively feel the operation of the printing press and fault handling methods. The SHOTS printing simulation system does not produce paper, ink loss, and loss and depreciation of the press compared to actual printing. Since there is no need for an actual machine but only the operation on the computer, the safety of the trained operators is also guaranteed.



Figure 1 Printing hall of SHOTS printing simulation software

SHOTS printing simulation software has three highlights. First, troubleshooting is undoubtedly a good tool for learning and upgrading printing technology. In the actual printing, the worker's diagnosis of the fault is generally based on their own practical experience, but the accumulation of these experiences needs many years of machine operating experience to sum up, and personal practical experience can not be very comprehensive. The SHOTS printing simulation system gives us a shortcut, it brings together the practical experience of printing experts on European countries, more than 600 kinds of printing failure cause listed, from these reasons can easily find solutions and impress, This allows trainees to easily troubleshoot in future actual printing operations even if they do not encounter similar failures. Second, the simulation of printing time cost and printing cost is also a bright spot. It is similar to the printing ERP management system. Through this module,

operators can understand the time and cost required to solve actual problems. In the simulation software, the consumption of materials such as the replacement of paper, ink, printing plate, fountain solution, rubber blanket, rubber rollers and other parts has corresponding costs. As long as the unit quantity loss value is pre-designed, the simulation software will automatically calculate the cost of consumption during the user's operation. At the same time, corresponding to each step of the operation, SHOTS has its corresponding time spent in actual operation. This feature allows the operator to basically test the time costs and expenses he or she has spent solving the actual printing failure, thus making a preliminary assessment of his or her capabilities. More importantly, an optimal operation plan can be found through a series of operations to maximize the actual benefits of printing. Third, the SHOTS printing simulation system can also simulate small changes in actual printing. A small change in a certain parameter like this may cause a big difference in print quality, while SHOTS can simulate the change of the sample when the parameter changes. The operator can visually observe the impact of each parameter on the printing process, thus giving a deeper understanding of the printing process [5].

There are standard mode and practice mode in SHOTS training. The system includes more than 300 practice questions, including about 200 GATF standards offset printing process training and examination questions, as well as various other standard practice questions. The operator can have a substantive understanding of the printing process through exercises, and gradually accumulate experience in solving printing failures through continuous practice. Operators can also edit exercises themselves through the Trainer module and conduct targeted assessments. The advantage of the SHOTS printing simulation system is that it can set the level of difficulty according to the different professional levels of the trainees, so that all trainees can get the most suitable training for them, and truly "teach students in accordance with their aptitude". By practicing fully on THES printing simulation system before on-the-machine operation, you can greatly shorten the training time and save the training cost.

Virtual simulation experiment teaching centers of some universities are developing printing virtual simulation experiment teaching management system, printing production lines virtual simulation experiment, and full-automatic wireless perfect binding linkage line virtual simulation experiment. The virtual simulation experiment project of the printing production line will successively cover the whole process flow of flat plate offset press, flexographic printing machine, gravure printing machine, automatic perfect binding machine, automatic saddle stitching machine, etc. The project mainly for printing engineering, packaging engineering and other related professional students "printing professional internship" "printing process practice" and other practical courses to provide virtual simulation practice teaching. During the internship in the printing factory, students can use computers to learn how to operate printing presses, binding equipment, and post-press processing equipment in a virtual simulation environment through local or online learning. Virtual simulation experiment has two different modes: learning and evaluation. Students will finally complete a printing task assessment after repeated learning. In order to better achieve the teaching goals, the teaching design of projects and tasks can be adopted. Each project is carried out separately knowledge point explanation, virtual printing operation practice and physical printing practice practice "circular" step-by-step teaching methods, so that students in the learning process will be the theoretical knowledge quickly throughout the practice, and thus the virtual printing operation is used to guide the operation of physical printing equipment, so that knowledge points through each other, to improve learning interest, improve teaching results. Through the combination of virtual and practical learning methods, it solves the problems of safety, cost, and the small number of equipment set that may arise in large-scale experiments, and to solve the large-scale experiments to carry out high-speed dynamic process is not conducive to monitoring and display of the disadvantages. The virtual simulation experiment comprehensively improves students' innovative spirit and practical ability [6].

5. The Reform Measures of Virtual Simulation Practice Teaching

5.1. Establish Teaching Guidance-Simulation-Practical Closed Loop Operation

The teaching of every practical training project is inseparable from the explanation and guidance of theoretical knowledge points. Teachers should be based on the training objectives and requirements of printing engineering professionals, first through the printing theory knowledge, printing process and printing failure teaching cases to guide students, so that they have a clear understanding of printing theory, equipment operating procedures and printing failures. Then through the virtual simulation system to simulate and simulate operations, so that students can master the printing equipment operating procedures and analyze and solve printing failures proficiently [7]. Finally, verify the operation of the actual printing equipment to achieve proficiency in the operation of the printing equipment and to solve as much as possible various printing failures in the actual printing production.

5.2. Establish a Resource Library of Virtual Simulation Teaching Cases

Combined with students' learning situation, a virtual simulation teaching resource base is established to meet different levels and needs, different printing quality and associated failures. According to the teaching content and the actual printing equipment, the virtual simulation practice teaching content can be divided into three parts. First of all, the printing process is the basic part, mainly explaining and presenting the operation of common printing equipment and the connection between various components. Grasp the performance and printing parameters of each component to help students consolidate their theoretical knowledge. The second is the printing proof inspection part, which mainly explains and trains students to understand the working principle and detection methods of the density meter, spectrophotometer, gloss meter, whiteness meter, smoothness meter and other instruments and equipment. Consolidate students' mastery of paper and printed product performance testing in actual course experiments. The third part is the analysis and troubleshooting of printing failures, which mainly explains and trains the causes and troubleshooting methods of different printing failures in the actual printing process. According to the causes of different printing quality accidents, they are divided into several categories, including process failures, material failures and mechanical failures [8].

5.3. Online and Offline Combined Teaching Mode

Traditional practical teaching mostly uses the instructor's face-to-face way to operate. Due to the large number of students, the small number of equipment, and safety teaching requirements make the training content not in-depth, students do not have enough grasp of the printing press equipment structure and operating procedures, and the diagnosis and cause analysis of printing failures are not in place. Through offline teaching, virtual simulation teaching cases and multimedia courseware are made according to the virtual simulation system, and they are explained and analyzed in theoretical and practical classes. Through online teaching, students can view class materials through the corresponding learning platform, and carry out online communication, discussion and interactive Q&A to enhance students' learning enthusiasm and autonomy.

6. Conclusion

This paper introduces virtual simulation teaching into the practical teaching of the training of applied talents for printing engineering. The system vividly presents complex, abstract or difficult-to-experiment printing phenomena, processes, and production scenes to students through multi-dimensional visualization and dynamic interaction. Through continuous trial-and-error and repeated participation in printing simulation training, the students' learning enthusiasm and autonomy have been stimulated, their Creative Thinking has been enhanced, and the learning effect has been greatly improved. The Student-centered approach not only attaches importance to students' sense of experience and participation, but also attaches importance to the cultivation of students' ability to combine theory and practice, which can promote the cultivation of applied talents and enhance the

competitiveness of students in future employment in the workplace.

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