

# The Application of Virtual Simulation Technology in the Teaching Reform of Chemical Pharmaceutical Technology Practical Training in Higher Vocational College

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**Abstract:** With the progress of science and technology, virtual simulation technology has become an important tool for innovation in the field of higher vocational education. Especially in chemical pharmaceutical technology, which is a course with strong practicality. While the traditional practical training mode is limited by equipment, safety, cost, etc., which is difficult to meet the demand of teaching and enterprise. This paper focuses on the current situation and challenges of chemical-pharmaceutical technology practical training teaching in higher vocational colleges, discussing the reform significance and application examples of the introduction of virtual simulation technology on the course content, teaching mode and teaching effect, in order to build a modern teaching method that is efficient, safe and economical.

**Keywords:** Virtual Simulation Technology; Higher Vocational Colleges; Chemical-Pharmaceutical Technology; Practical Training Teaching

## 1. Introduction

Chemical Pharmaceutical Technology is a practical course that combines the basic theories of chemistry, drug synthesis and pharmaceutical processes and applies them to the synthesis and production of chemical drugs. This course is the core course of pharmaceutical production technology and other related majors in higher vocational colleges, with the characteristic of strong practicality, but the drug synthesis is complex and costly, and the school is not able to set up its own internship plant for its own majors, which makes it more difficult for students to learn and lacks engineering awareness and engineering practice ability<sup>[1]</sup>. Therefore, how

to combine basic professional knowledge, professional practical training and modern teaching methods in practical training to improve the quality of teaching and learning has become one of the key issues in the reform of chemical and pharmaceutical technology teaching in higher vocational colleges.

In recent years, with the development of information technology, the application of virtual simulation technology in chemistry and related disciplines has become more and more widespread<sup>[2]</sup>, and has become a powerful tool for chemistry, pharmacy and biological research. At present, virtual simulation teaching is widely used in the teaching process of clinical medicine<sup>[3]</sup>, machining<sup>[4]</sup>, chemistry<sup>[5]</sup> and art design<sup>[6]</sup>, etc. In this paper, we take the course of chemical pharmaceutical technology as an example to discuss the changes brought by virtual simulation technology in practical training teaching.

## 2. The Current Situation and Challenges of Teaching Practical Training in Chemical-Pharmaceutical Technology

The chemical-pharmaceutical technology course requires students to master the basic theoretical knowledge and basic experimental skills of modern chemistry and pharmaceuticals, and to be able to engage in production line management and engineering production in the fields of chemical industry, light industry, pharmaceuticals and environmental protection, etc., which is highly practical, applied and engineering. With the development of chemical-pharmaceutical industry, the production process involves a wide variety and quantity of chemical substances, many of which are flammable, reactive and toxic, resulting a certain safety risks<sup>[7]</sup>. With the expansion of the scale of production, the production operation has gradually achieved a high degree of

automation. Therefore, in the the background of pharmaceutical plant production gradually tends to safety, scale and automation [8], enterprises are no longer willing to accept students to the site to observe the internship, even if the intern students enter the enterprise, their engineering ability and awareness can not be strengthened. At present, the following problems exist in the teaching of practical training in chemical pharmaceutical technology courses:

### **2.1 Traditional Practical Training is Time-Consuming and Involves Little Content**

Chemical pharmaceutical technology courses are rich in practical content, but students can often only master some basic operating methods and skills in the limited practical training hours, it is difficult to comprehensively and systematically learn the engineering knowledge of the pharmaceutical production process, hindering students to broaden their horizons and enrich their professional knowledge.

### **2.2 Experimental Sessions Use More Organic Solvents**

In the practical teaching session, many chemical reagents may be used, and these chemical reagents are often explosive, flammable, toxic, corrosive, radiation and other dangerous characteristics. If used improperly, they may cause burns and explosions, resulting in personal injury, property damage and other accidents.

### **2.3 Lagging Conditions for Practical Training**

At present, subjecting to the constraints of experimental sites, school funds, time costs and other factors, most professional practical training courses in higher vocational colleges are still limited to the a small scale in laboratory. For example, in the drug synthesis experiment, students only rely on the construction of glass instrumentation devices, and manual control experimental conditions to synthesis simple drugs, although it can exercise the hands-on ability of students, it is far from the current situation of industrial production, the students can not be good to meet the development of enterprises on the real demand for skilled personnel.

### **2.4 Lack of Engineering Literacy Among Teachers**

Most of the teachers in higher vocational colleges have too much academic thinking, no practical experience in factories, far from enough ability and energy in engineering technology and industrial practice, and they may not fully understand the technological progress of the pharmaceutical industry and the real needs of enterprises for talents, so it is very difficult to achieve the practical teaching objectives.

## **3. The Significance of the Application of Virtual Simulation Technology in Practical Training and Teaching**

Virtual simulation teaching is the use of virtual simulation reality, three-dimensional animation and demonstration, human-computer interaction and other technologies, according to the needs of theoretical and experimental teaching to design a virtual scene for supporting teaching, virtual environment, virtual equipment and components library, demonstration of theoretical and experimental processes and other content, using different software design and application technology, relying on the platform as well as the subject attributes, with the characteristics of different professions and courses for the design and development of Teaching<sup>[9]</sup>. The introduction of virtual simulation technology into the practical training teaching of chemical pharmaceutical technology, so that the teaching content is more visual, concrete, intuitive, can effectively stimulate students' learning interest, students can be more proficient through the actual hands-on operation of the safe production process of drugs<sup>[10]</sup>.

### **3.1 Achieving Multidisciplinary Cross-Fertilisation**

The simulation teaching of chemical pharmaceutical technology covers many courses. Students can make a comprehensive evaluation of the mastered knowledge through simulation experiments, and have a clearer perception of the connection, integration and application of different knowledge. For example, in the 3D simulation experiment of trazodone hydrochloride production process, through the learning of process knowledge, students can understand the division of the

drug production area, the connection of each section, the arrangement of equipment and the sequence of material flow.

### 3.2 Equal Scale Reduction of Industrial Production Process

The production process of drugs is composed of a series of unit reactions and unit operations, involving many links and complex processes. In the practical teaching process, the teacher usually only demonstrates the typical equipment or process, so the students are unable to understand and be familiar with a large number of necessary control points for actual production. In addition, the control of the production process can not be achieved only by demonstration experiments. The virtual simulation teaching software can effectively solve the above problems by restoring the actual production equipment and process according to the ratio of 1:1, which can truly present the process of industrial production.

### 3.3 Stimulate Students' Enthusiasm for Learning

The traditional practical training teaching mainly adopts the mode of offline physical teaching, which is based on the teacher's on-site lecture on the experimental process, the students are in the state of passive listening. Virtual simulation technology combines animation and audio effects to simulate the real experimental process, students learn the whole process of drug production through simulation software. Simulation software of the 3D interface and simulation of the operating system make students seem to be placed in the simulation game, not only can be immersed in the completion of a variety of operations, but also make the students in a pleasant atmosphere to learn.

### 3.4 Improve the Efficiency of Experiment

Virtual simulation experiments can help students quickly master the specific objectives of experimental research and experimental techniques through online learning functions. Remote virtual simulation experiments break through the limitations of physical space, greatly improving the efficiency of learning and research, providing strong support for practical training teaching sessions. In summary, through the application of virtual

simulation technology, the expected learning results can be achieved with no entering the training room for actual operation, and this combination of virtual and real, complementary form of teaching can stimulate students' learning interest, effectively improve the quality of practical training teaching.

## 4. The Application of Virtual Simulation Technology in the Practical Training Teaching of Chemical Pharmaceutical Technology

Trazodone hydrochloride is a derivative of triazolopyridine and is used clinically for the treatment of depression, with both anxiolytic and antischizophrenic effects. Trazodone hydrochloride is usually prepared as a piperazine derivative in the presence of sodium hydride or in the presence of potassium carbonate. If the complete process is applied in real practical training, there are disadvantages such as long time-consuming practical training, high cost of raw materials, high energy consumption, irreversible operation, etc., and it is not suitable for large-scale classroom teaching. In order to solve the above problems, the school cooperated with a simulation software technology limited company to introduce the production process of Trazodone Hydrochloride. The process adopts the form of 3D scenario and integrates GMP and SOP points in the software scenario and operation process, which can carry out the simulation operation from dressing, production to the internal and external packaging of the product. Through the simulation software online simulation of the production process of Trazodone Hydrochloride, students can be familiar with the actual operation of the entire process, master the operation and adjustment of the parameters and indicators of chemical pharmaceutical production, and ultimately master the chemical pharmaceutical production of the deep-rooted operational process.

## 5. Conclusion

The course content of chemical and pharmaceutical technology involves a wide range, focusing on practicality and innovation. Integrating virtual simulation technology into practical training teaching, in accordance with the principle of "combining virtual and real, complementing each other, and being able to be real but not virtual", combining with the

actual teaching needs of the course, and innovating the practical training teaching mode, can make up for the shortcomings of the traditional teaching mode to a certain extent, for example, involving high-risk or extreme environments, inaccessible or irreversible operations, high costs and high consumption, etc. At the same time, the vividness and interest of virtual simulation technology also make students change from passive learning to active learning.

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### References

- [1] Jiaogang Lin, Yanhua Zhang,. Research on the Application of Virtual Simulation Technology and Vocational Education Teaching[J]. Journal of Physics Conference Series, 2020, 1544(1):012089.
- [2] Tao Sui, Xiuzhi Liu, Dongya Lu, et al. Research on the construction of teaching case library of the computer simulation technology[J]. Multimedia Tools and Applications, 2019, 78(1):1183-1199.
- [3] Garnier Alexandra, Vanherp Romain, Bonnabry Pascal, et al. Use of simulation for education in hospital pharmaceutical technologies: a systematic review.[J]. European journal of hospital pharmacy : science and practice, 2021, 30(2).
- [4] Meng Li, Yongxiang Li, Haixia Guo, et al. Research and application of situated teaching design for NC machining course based on virtual simulation technology[J]. Computer Applications in Engineering Education, 2020, 28(3):658-674.
- [5] Yin Liu, Huili Lu, Weiwei Zhang, et al. Design and Exploration of Virtual Simulation for Safety Education in Chemical Laboratory Teaching[J]. University Chemistry, 2023, 38(12):242-249.
- [6] Liang Bin, Art Design Teaching Based on the Multidata Fusion Algorithm and Virtual Simulation Technology[J]. Mobile Information Systems, 2022, 2022.
- [7] Ma Xiaoyan, Chen Guohua, Zhao Hai, et al. Construction and Practice of Virtual Simulation Experiment Teaching Center for Pharmaceutical Engineering[J]. Guangdong Chemical Industry, 2023, 50(14): 228-231.
- [8] Shuzhen Chu, Chunmei Sun, Pharmaceutical Enterprises' R&D Strategic Alliance—— the Road for Small and Medium Sized Pharmaceutical Enterprises' R&D in China[J]. International Business Research, 2010, 3(1):131.
- [9] Hongna Qi. Research on Artificial Intelligence Empowering Teaching Reform in Higher Vocational Colleges[J]. International Journal of Education and Humanities, 2024, 11(3):208-210.
- [10] Salsabeel F. M. Alfalah, . Perceptions toward adopting virtual reality as a teaching aid in information technology[J]. Education and Information Technologies, 2018, 23(6):2633-2653.