

# Research on Virtual Simulation Experiment Teaching of High School Biology under the Guidance of Design Thinking

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**Abstract:** The application of design thinking in subject teaching is helpful to cultivate students' innovation ability, and it is of great value to apply design thinking to the virtual simulation experiment teaching of high school biology. By analyzing the application status, teaching methods, advantages and disadvantages of virtual simulation experiment in high school biology teaching, this paper explores the effectiveness and innovation of virtual simulation experiment in high school biology experiment teaching based on design thinking.

**Keywords:** Design thinking; Virtual simulation experiment; High school biology; Biological experiment teaching

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## 1. Introduction

Experimental teaching is an important support for the cultivation of core literacy of high school biology. The design of high school biology experimental teaching should be diversified and digital, and virtual experiments should be conducted by making full use of multimedia, Internet and wireless communication technology when conditions permit <sup>[1]</sup>. With the development of virtual simulation technology, virtual simulation experiment has also become an important part of experimental teaching, which has been further promoted and applied under the background of national education digital transformation. In 2019 alone, there were 296 national virtual simulation experimental teaching projects identified by the Ministry of Education, and a sharing platform for centralized display of virtual simulation experimental teaching projects has been built <sup>[2]</sup>. With the support of national policies and funds, some universities and middle schools have planned and built virtual simulation laboratories. For example, the virtual simulation Laboratory of Psychology and Behavior established by Central China Normal University and the virtual simulation experiment of medicine and architecture built by Jinggangshan University in 2019 ; Under the guidance of colleges and universities, many middle schools have also actively carried out relevant virtual experiment teaching, which is mainly reflected in the application construction of experimental subjects such as biology, chemistry and physics .

Starting from the overview of virtual simulation experiment, this paper sorts out and analyzes the current situation of high school biology experiment teaching in literature, the necessity, advantages and disadvantages of virtual simulation experiment in high school biology teaching. Based on the shortcomings of the current application, this paper uses the design thinking model to explore the effectiveness and innovative application of virtual simulation experiment in high school biology teaching.

## 2. Concept overview

### 2.1 Concept of virtual simulation experiment

The concept of virtual simulation experiment was put forward by Professor William Wolf of University of Virginia in the United States, and was initially used in military simulation training. Virtual simulation experiment refers to a new teaching method that people use computer technology and virtual reality technology to create a virtual simulation environment, simulate the real experiment process through software program and realize the corresponding experiment operation. Virtual simulation experiment allows students

to simulate the actual field operation in the virtual environment and obtain the results and experience that can not be obtained in the actual operation, so as to improve students' experimental skills and theoretical literacy. China's virtual simulation experiment started relatively late, and started to carry out the construction strategy of national virtual simulation experiment teaching center in 2013 . With the continuous development of computer technology, virtual simulation experiment has been improved and perfected, and its application scope is more and more extensive, involving physics, chemistry, biology, medicine, machinery, electronics and other fields. At present, virtual simulation experiment has become an important part of modern education, providing a new possibility for education and teaching.

## **2.2 Characteristics of virtual simulation experiment**

Starting from the role of virtual simulation experiment in teaching, it has the characteristics of high simulation, intelligence, dangerous experiment, intuitiveness, openness and sharing . The features of high simulation are reflected in the high degree of simulation of the equipment provided by the virtual simulation laboratory, which is convenient for students to operate and observe experiments; Intellectualization is reflected in the experiment process to automatically enter the next link to remind and help students to carry out experiments; Dangerous experiments are presented in the form of virtual simulation in some dangerous physical and chemical experiments, and can simulate different experimental results according to students' experimental operation; Compared with the teaching of abstract concepts in traditional experiments, virtual simulation experiments can be displayed in the form of animation demonstration, so as to make up for its shortcomings. Openness and sharing is reflected in the students can log in to the virtual simulation experiment platform anytime and anywhere with the account and password for learning and interaction.

## **3. The application of virtual simulation experiment in high school biology teaching**

### **3.1 Application status of virtual simulation experiment in high school biology teaching**

At present, from the perspective of the construction of virtual simulation experiment teaching environment, high school biology virtual simulation experiment teaching mainly relies on the original information teaching equipment to install virtual simulation experiment system teaching software to teach. Most of them are presented in the form of two-dimensional animation, with weak immersion, weak interaction, and low requirements on the operating environment. The application of such virtual simulation experiments in teaching needs to be combined with real experiments to help students understand the experimental steps and improve the interest and quality of experimental teaching. For example, virtual experiment of semi-permeable membrane, virtual experiment of mark recapture method and virtual experiment of plant tissue culture in high school biology experiment. At present, virtually no virtual simulation laboratory is built in high school biology teaching. The reason is that the construction of virtual laboratory requires a high level of investment. The advantages are high adaptability, good interaction, strong sense of student participation, and can support multi-disciplinary virtual simulation experiments. Therefore, there are many constructions in colleges and universities, such as medical and architectural virtual simulation experiments for medical majors, psychological and behavioral virtual simulation laboratories for psychology majors, chemical virtual simulation laboratories for chemistry majors, and so on.

### **3.2 Advantages of application of virtual simulation experiment in high school biology teaching**

There are many problems in the traditional experimental teaching of high school biology. First of all, in the construction of school equipment, most schools can carry out the conditions of biological experiment teaching, but the experimental equipment is not complete, only a few microscopes and chip loading, and only invest in hardware equipment . In terms of teaching, biological experiment teaching is not paid much attention, the experimental teaching is not carried out at a high level, the experimental teaching hours are less arranged, and the experimental teaching ability of teachers is insufficient. Most teachers only verbally describe the experimental process in experimental teaching, or use experimental video explanation . In terms of learning, students are very interested in biology experiment teaching and hope to have hands-on practice opportunities. However, the teaching methods of teachers are different from students' expectations, which will reduce the enthusiasm of learning biology. Or in the process of experimental teaching, it is somewhat difficult for students to complete the experiment independently, and there are certain safety risks in the process of experiment . The characteristics of virtual simulation experiment, such as intuitiveness, high simulation and dangerous experiment, can provide a solution for the application of high school biology experiment teaching.

## **4. Innovative application of high school biology virtual simulation experiment teaching under the guidance of design thinking**

There are many classical models in the application process of design thinking, including IDEO's design thinking model,

including Discovery, Interpretation, Ideation, Experiment and Evaluation. EDIPT models proposed by D.School include Empathize, Define, Ideate, Prototype and Test. The methods used in different links are also different. At present, the commonly used methods include observation, interview, empathy map, brainstorming method, five questions method, 6W2H method, world coffee method, etc.

Based on design thinking model and tool method, EDIPT design thinking model can be used to optimize the virtual simulation experiment platform in high school biology experiment teaching. The first is the empathy stage. Before the virtual simulation experiment teaching, the virtual simulation experiment platform can construct a situation related to real life for the problems to be solved in the experiment, or construct it in combination with the real situation in real life, so that learners can personally understand the necessity of problem solving, and design online discussion among multiple people synchronously or in groups. Find and analyze problems in the process of observing and listening. The second is the definition stage. According to the students' preliminary inquiry, the problems to be solved in the experiment are clearly defined. The elements, key points and goals achieved can be described in the virtual simulation experiment platform, and the input data and content can be displayed in the form of scientific visualization to visually express the key points of the experiment. The third is the conception stage. The study is based on brainstorming. The study group discusses the experimental steps and key points and determines the specific steps of the final experiment. The fourth is the prototype stage. According to the preliminary experimental preparation, the steps needed for the experiment are provided on the virtual simulation experiment platform, and the experimental steps are set and organized based on the results of group discussion. Finally, in the test stage, students show the experimental operation process and observe the experimental phenomenon. Teachers and each group can conduct comprehensive evaluation on the virtual simulation experiment platform, and the group can further optimize the experiment key points, steps and precautions.

## 5. Summary

In recent years, the content and quantity of experiments have been added to the biology textbooks in the new curriculum standard, which significantly raises the requirements for teachers and students' experimental skills. At present, the equipment construction and teachers' ability of experimental teaching in high school biology are still lacking. How to better adapt to the curriculum reform under the transformation of digital education and improve the quality of high school biology experiment teaching will be a major challenge in high school biology experiment teaching. The application of virtual simulation experiment platform will inject new vitality into high school biology experiment teaching. At present, the construction of virtual simulation experiment platform only stays on the basis of animation demonstration operation. Under the guidance of the methodology based on design thinking, virtual simulation experiment platform will improve its shortcomings in empathy and other aspects, provide a supplement for teachers to carry out real experiment teaching, optimize the experimental teaching content, and increase the space for students to learn independently. The guidance of design thinking will provide inspiration for the construction of virtual simulation experiment platform, better integrate it with high school biology experiment teaching, improve and cultivate students' innovative thinking and experimental skills.

## References:

- [1] Ministry of Education of the People's Republic of China. Curriculum Standard of Biology for General High School (2017 Edition, Revised 2020) [M]. Beijing: People's Education Press, 2020:2-3,59.
- [2] Yin Jialin. Application of Virtual Simulation Technology in Junior High School History Teaching [D]. Qufu Normal University, 2022.

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