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Retraction

Retracted: Construction of Marine Professional Virtual Simulation Experiment Platform Based on Internet-of-Things Technology

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

(1) Discrepancies in scope
(2) Discrepancies in the description of the research reported
(3) Discrepancies between the availability of data and the research described
(4) Inappropriate citations
(5) Incoherent, meaningless and/or irrelevant content included in the article
(6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

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[1] J. Yan and H. Jia, "Construction of Marine Professional Virtual Simulation Experiment Platform Based on Internet-of-Things Technology," *Security and Communication Networks*, vol. 2022, Article ID 2833741, 8 pages, 2022.

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Research Article

Construction of Marine Professional Virtual Simulation Experiment Platform Based on Internet-of-Things Technology

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In order to meet the needs of high-intensity underwater information confrontation training under complex battlefield conditions, military academies must integrate scientific issues related to environmental operations into classroom teaching through research-based teaching of marine environmental effects. By analyzing the research-oriented teaching requirements of marine environmental effects, the design and implementation of a virtual simulation laboratory based on a high-performance computing platform for signal-level marine environmental effects are discussed. Multilevel, research-based teaching provides effective technical support, which is of great significance to helping submarine professional students experience, recognize, and master the scientific laws behind combat problems, improve their practical training capabilities, and promote practical teaching. By the time the number of operations reaches 5, most students have an accurate grasp of the liquid chromatography procedures. After more than five times, the improvement of students is not obvious. Compared with liquid chromatography, the improvement of Bernoulli experiment is divided into two stages: 1 to 5 times belong to the process improvement stage, and students can master it quickly; 6 to 12 times belong to the detail improvement stage, and the improvement times are relatively slow; fully mastered the time required is much higher than the liquid chromatography virtual simulation experiment. Finally, combined with the actual teaching application, the research-based teaching group training mode and relevant implementation suggestions are summarized.

1. Introduction

The Internet of Things (IoT) originated in the media field and is the third revolution in the information technology industry. The Internet of Things refers to the connection of any object with the network through information sensing equipment according to the agreed protocol, and the object exchanges and communicates information through the information transmission medium to realize intelligent identification, positioning, tracking, supervision, and other functions. Network virtual experiment is a very important activity for computer network experiment courses in colleges and universities. Through network virtual experiment, we can simulate the working principle of protocol or network environment, bring a lot of benefits to students' deep protocol theory learning, and overcome the limitations of time, space, and equipment in the real experimental environment. However, the current design of the virtual experiment platform still has the following problems: (1) the experiment set by the virtual experiment platform is fixed, which cannot provide personalized needs according to the specific situation of students. The use setting of the virtual experiment platform is designed by the designer according to the experience of teachers and will remain unchanged for a certain period of time. However, in the teaching process, it is found that with the continuous development of technology, the problems existing in students' learning process will change over time, which is not eternal [1, 2]. (2) The virtual experiment platform can only record students' experiments, not the experimental process, which makes teachers unable to effectively understand the problems existing in the process of students' experiment. After the virtual experiment is completed, the teacher gets the experimental environment and experimental report made by the students on the platform, and the problems existing in the experiment process cannot be understood in detail by the teacher unless a classmate puts forward them to the teacher. (3) The virtual experiment platform can only analyze and count the results of students' experimental results and cannot provide teachers with analysis reports of students' problems. The advent of the era of big data has also brought great challenges and opportunities to education. The most valuable thing in the era of big data is data, and in the process of virtual platform experiment, you can obtain a large amount of data information of students in the process of experiment, such as what device was dragged in the platform, what device was deleted, what command was entered, and what information was queried by opening the browser. If these data are recorded, a large amount of valuable data information can be obtained [3, 4]. How to make effective use of this information, we need to analyze these data with the help of data mining and machine learning technology. At present, the algorithms related to data mining and machine learning have been very mature and widely used in big data analysis in various fields, which also provides a technical guarantee for analyzing big data information in experimental courses. In the era of big data, it is of great significance to carry out the teaching reform of computer network experiment course under virtual experiment [5]. Marine platform is a national tool for developing offshore oil and gas resources and ensuring national energy security. Experimental analysis relying on national major projects, key research and development project latest scientific research achievements, ship and marine engineering A + subject advantage, independently developed the ocean platform installation virtual simulation teaching platform, build the engineering case as the main line, with numerical model as the core of progressive experiment system, make up for the ocean platform installation entity experiment risk, high cost, not shortcomings, theory teaching and engineering time depth fusion, and to cultivate engineering and technical talents have played an important role.

2. Literature Review

Martínez et al. believes that practical teaching is an effective way to consolidate theoretical knowledge and deepen theoretical understanding, an important link to cultivate high-quality talents with innovative consciousness and practical ability, and an important means to meet the current social demand for talent knowledge structure. For marine geoscience-related majors, practical teaching is an important part of the undergraduate teaching system. However, due to the imperfect teaching system and teaching facilities, especially for some practical teaching with high cost, long cycle, and irreversibility, it is difficult to carry out. It can only be "on paper," which is difficult to achieve the ideal teaching effect [6]. Casadei et al. believes that with the continuous development and deepening of information technology, education informatization has been highly valued by the state. The ministry of education proposed to carry out the construction of virtual simulation experiment teaching is of great significance—virtual experiment. The experimenter can simulate the real experimental environment, complete various scheduled experimental projects, obtain intuitive and real experimental results, and show the invisible structure or principle, so as to quickly respond to the needs of teaching experiments. Mike believes that virtual experiment has the characteristics of low-cost, high efficiency, strong scalability, safe operation, high openness, and resource sharing. At present, the cultivation of students' innovative consciousness in virtual experiment teaching has become an important direction of Virtual Experiment Teaching [7]. Farooq et al. of the College of Marine Geosciences have constructed the teaching system of marine geoscience virtual simulation experiment and the teaching sharing platform of marine geoscience virtual simulation experiment by using information means such as virtual reality and human–computer interaction. In 2015, the Ministry of Education approved it as the national virtual simulation experiment teaching center of marine geoscience. The application of this system makes up for the shortcomings of real experiments, expands the experimental teaching content, expands the opening of large instruments and equipment to undergraduate teaching, and enables students to complete the learning and operation of relevant experiments without leaving home, making the practical teaching of expensive, irreversible experiments and micro-experiments, and realizing the good connection and transition between theoretical teaching and real field practical teaching [8]. Tang et al. believes that virtual simulation teaching breaks the restrictions of time and space, makes the difficult experimental teaching simple, intuitive, and practical, and the experiment is green and safe. It can carry out exploratory operation arbitrarily and has achieved good teaching results. At present, the College of Marine Geosciences has three undergraduate majors, including geology (Marine Geology), exploration technology and Engineering (marine geophysics), geo information science, and technology (geo information science and technology and marine surveying and mapping and geographic information system). The talent training of the three majors has remarkable marine characteristics [9]. Behera et al. believes that there are the following problems in practical teaching: (1) the experimental space conditions are limited, and there are risks in offshore practical teaching; (2) the teaching cost is high, and some experimental contents are difficult to carry out on the real experimental platform, irreversible, and long cycle; (3) micro and abstract experiments are difficult for students to achieve a comprehensive understanding. The above problems make it difficult to carry out practical teaching in an all-round way, and it is difficult to achieve the ideal teaching effect based on the existing conditions. In view of the above problems, the college follows the construction idea of "based on professional teaching, paying attention to discipline intersection, highlighting marine characteristics and focusing on discipline development." With the goal of comprehensively improving students' innovative spirit and practical ability, we use virtual reality, human–computer interaction, and other information technologies. In order to expand the field of practical teaching, enrich the content of practical teaching and carry out green experimental teaching, follow the principles of virtual reality combination, mutual supplement, and real ability, combined with the teaching and scientific research achievements of the college, build a Marine Geoscience virtual simulation experiment teaching system and build a Marine Geoscience virtual simulation experiment teaching sharing platform [10]. Yao and Ansari built a structured, systematic, and highly simulated virtual experiment environment and experimental teaching resources by using information technologies such as virtual reality, multimedia interaction, web, and 3D visualization through independent research and development, joint research, and continuous investment [11]. Skiadopoulos et al. believe that the existing virtual experiment teaching includes experimental projects with high cost and high consumption, such as virtual operation experiments of various seabed exploration equipment. The real experimental platform is difficult to carry out, irreversible, and long-term experimental projects, such as the observation experiment of submarine hydrothermal and cold spring, and experimental projects that combine virtual reality and complement each other, such as virtual field practice, crystallography, and mineralogy virtual experiment [12]. Sheng et al. believes that the development of these virtual experiments makes up for the shortcomings of real experiments. At present, the system includes three virtual simulation experiment teaching platforms, including seabed exploration technology, Earth science field practice, and characteristic course experiment, with a total of 15 virtual simulation experiment teaching modules [13]. Bousdekis et al. believe that the big data analysis applied by the virtual experiment platform can track the experimental process of students in time and guide the experimental process in time, so as to prevent students from discovering errors at the end of the experiment, resulting in the experiment having to start from scratch. The effective combination of the analysis results and the experimental process can make up for the problems of teachers' failure to provide timely guidance to a certain extent, and mobilize students' learning enthusiasm [14]. Jain et al. believes that in the traditional experimental process, when students find problems, they ask questions to teachers or inquire relevant information on the Internet. By reforming the virtual experiment platform, we can understand what relevant auxiliary knowledge students need in the experiment process from students' historical operation records, and provide help to students in time [15]. Negash et al. believe that it can more effectively understand students' learning. The problems existing in the experimental operation are often closely related to the theoretical curriculum. Through the reform of the experimental platform, teachers can understand the problems existing in students from the experimental process, and can make more targeted supplements in the theoretical curriculum [16].

On the basis of the current research, this paper discusses the design and implementation of a virtual simulation laboratory for the construction of a signal-level marine environmental effect based on a high-performance computing platform by analyzing the research-oriented teaching requirements of marine environmental effects. The platform provides effective technical support for the realization of multilevel, research-based teaching of marine environmental effects. It is of great significance to help submarine professional students experience, understand, and master the scientific laws behind combat problems, improve their practical training capabilities, and promote the level of practical combat teaching.

3. Design and Implementation of Virtual Simulation System for Marine Environmental Effects

3.1. Design Idea. According to the research teaching needs of submarine students on marine environmental effects, the construction of a high fidelity "artificial battlefield" is the primary condition for the start of war in the laboratory. Under the support of large-scale database, the simulation model system of marine environment prediction, channel transmission, target characteristics, force engagement, and so on, which meets the needs of signal-level combat experiment, is constructed to provide basic conditions for the virtual simulation of marine environment effects. At the same time, it must meet the real-time requirements of engagement simulation, which is very difficult to design and implement. The main design concept is (Figure 1): (1) the operational sea area is wide and the environment is complex and changeable. In order to realize the refined channel environment simulation, it is necessary to establish a signal waveform prediction model with good sea area adaptability, accuracy and real-time, especially the accurate simulation of the marine level nonuniform environment. (2) In actual simulation, it is necessary to put multiplatforms, multisensors, and multiweapons under unified space-time conditions. It is not only necessary to solve the coupling problem of environment, sensors, and weapons, but also to solve the different space-time granularity and space-time coupling problem of engagement-level simulation and signal-level simulation. (3) The signal-level underwater combat experiment needs to realize the signal-level simulation of the whole process of underwater information countermeasure, that is, the whole process of signal generation, transmission, interaction, acquisition, and signal processing of underwater information countermeasure is consistent with the actual combat. Its simulation time granularity is second level and involves cross platform, cross system, and cross discipline. It must be realized by relying on the combat parallel simulation technology. At the same time, in order to improve the high availability, flexibility, and easy scalability of the system and reduce the construction cost, the signal-level parallel simulation calculation based on the high-performance computing platform must be realized [17].

3.2. Design Realization. Signal-level ocean environment virtual simulation is based on the signal characteristics of underwater target and its transmission in ocean channel and uses signal processing technology to reproduce the signal interaction process in the process of weapon equipment detection and confrontation. Using supercomputing

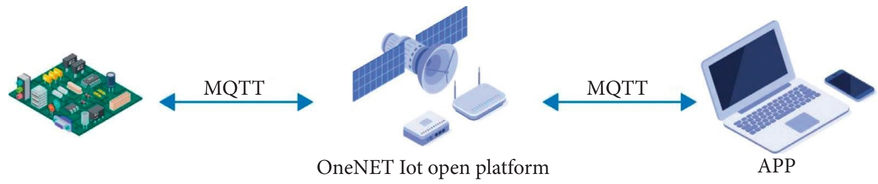

Figure 1: Virtual simulation of internet of things technology.

technology, system analysis, efficiency evaluation, and other methods, under the condition of human control, it is a scientific experimental activity to investigate the process and outcome of underwater warfare and understand the law of underwater warfare. Its core idea is to capture the influence of complex battlefield environment on sensors, weapons, and platforms from the original form of information—signal waveform. Put all elements under the unified space-time and battlefield environment background conditions, construct a full platform, full system, full elements, highly realistic virtual combat environment, and systematic signal-level simulation experiment ability, completely reproduce the whole process of underwater information transmission, detection, and confrontation, and provide a scientific basis for the research-based teaching of virtual simulation of marine environmental effects [18]. The overall structure of the laboratory is shown in Figure 2.

(1) High-performance computing platform. High-performance computing platform is an important infrastructure to improve the research level and ability of the laboratory. It adopts the dawning blade parallel cluster solution with high-performance price ratio and good scalability. With the help of remote management function, realize virtual field control and management and provide remote job submission, cluster status query, cluster fault remote consultation system, and other functions for different levels of application problems and users, so as to effectively use the computing power of the cluster to mainly complete the high-performance parallel simulation calculation of complex underwater acoustic propagation and sonar detection efficiency. Complete the simulation and verification of operational application level and model level.

(2) Underwater target and environmental information database platform. The database platform establishes the marine environment information database, model database, and application product database. The database software system of the platform plans to adopt Oracle database system, and use the theory and design method of data warehouse to uniformly store and manage marine environment data, models, and application products, so as to provide users with hierarchical and multilevel applications such as basic data, data products, and application product data. While ensuring the safe and stable operation of the database, it provides a guarantee for the interactive sharing and efficient management of the information stored in the database [19].

(3) Signal-level sonar system simulation platform. The main functions of the platform include the simulation of signal source waveform and its transmission characteristics, the simulation of signal field and background field, the parallel algorithm of sonar signal processing, the architecture combining shared memory and distributed storage, and the mixed parallel programming model based on (Magnetic Particle Inspection, MPI) + (Open Multi-Processing, OpenMP) to realize the signal-level simulation based on the high-performance computing platform, so as to provide the function of sensor level environmental effect evaluation for the marine environment virtual simulation laboratory.

(4) Visual combat application research platform. Visual combat application research platform is one of the important open virtual simulation research and human–computer interaction platforms of marine environmental effects in the laboratory. Based on the distributed force simulation technology based on high-level architecture (HLA) and the three-dimensional visual expression technology of underwater battlefield environment, the platform establishes the force engagement-level simulation system and underwater battlefield environment visual display system. This realizes the human in the loop force engagement-level simulation and the three-dimensional visual expression of underwater battlefield environment, and can further improve the students' analysis ability and decision-making level of underwater combat space [20].

3.3. Data Distribution. Because the credits and class hours of instrumental analysis and chemical engineering principle experiment are the same, this paper averages the scores of the two experiments and obtains the scores of practical experiment and virtual experiment, respectively. The distribution of students' experimental scores is shown in Figure 3: the average score is 82.43 points and the variance is 19.94; 61.36% of the students scored above 80; 3.27% of the students were excellent. The K–S test value of the actual distribution and normal distribution of the results of the practical experiment is 0.0972, and the maximum difference appears at the position of 80 points, indicating that the practical experiment conforms to the cognitive law of traditional students.

Compared with the approximate normal distribution presented by the practical experimental teaching, the scores of virtual simulation experiments show significantly

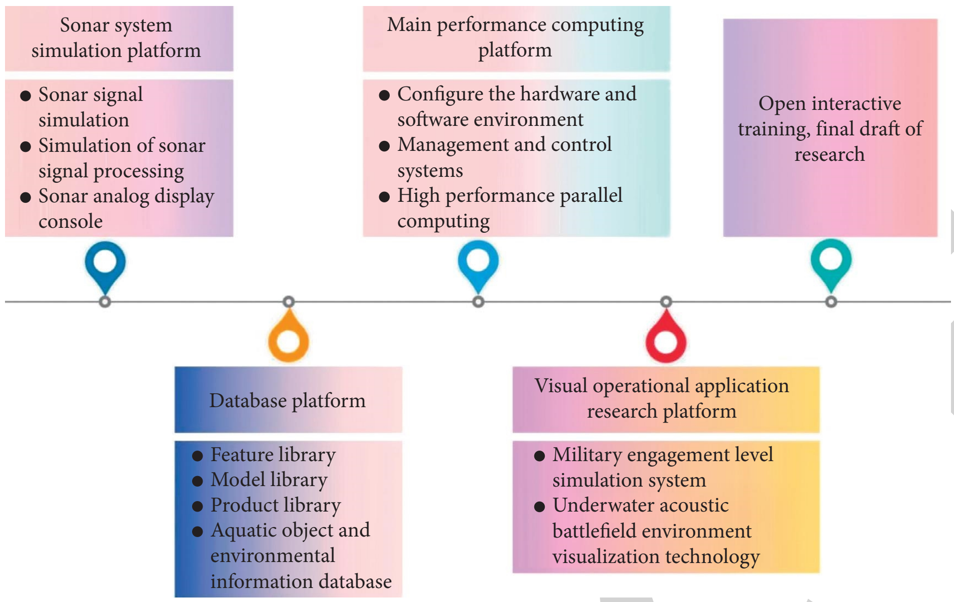

FIGURE 2: Overall structure of the laboratory.

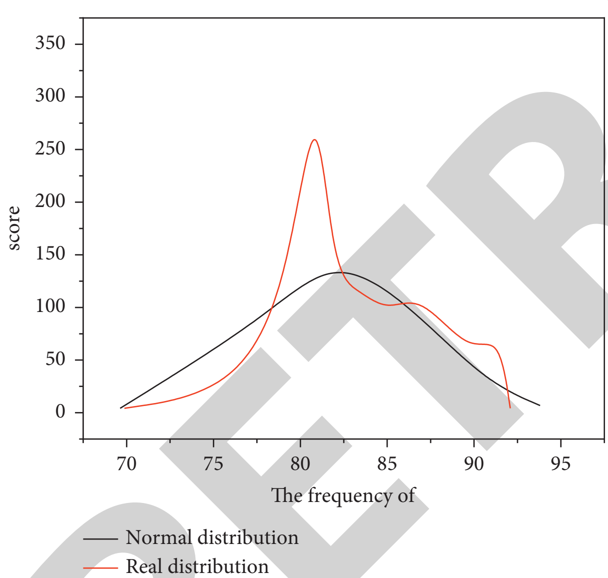

FIGURE 3: Probability density distribution of students' experimental results from 2019 to 2020.

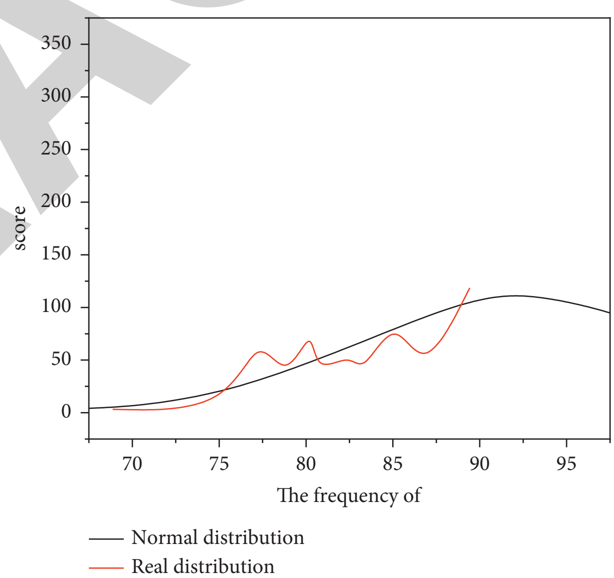

FIGURE 4: Probability density distribution of virtual simulation experiment results.

different probability distribution patterns (see Figure 4): the average score is 90.92 points and the variance is 51.74; 57.19% of the students scored above 90; 38.48% of students can get excellent rating. The average score of virtual simulation experiment is 9.77% higher than that of practical experiment, and the statistical effect is remarkable [21].

Compared with the actual experiment with a small number of sets, students can personally operate the virtual instrument through the network and practice the operation steps and standardization for unlimited times. After a certain number of repetitions, most students can skillfully master the operation and data processing methods of virtual simulation experiment, so as to achieve better test results. At the same time, compared with the actual experiment, the operation of virtual simulation experiment is moderately simplified, which is also conducive to the improvement of students' performance.

4. Analysis of Teaching Effect of Virtual Simulation Experiment

4.1. This Paper Uses Four Evaluation Indexes to Analyze the Teaching Effect of Virtual Simulation Experiment.

(1) Pearson correlation coefficient *r*. It is used to measure the correlation between two variables: the closer

r is to 1, the better the correlation between two variables and the more consistent the trend change:

$$r = \frac{\sum_{i=1}^{n}(X_i - \overline{X})(Y_i - \overline{Y})}{\sqrt{\sum_{i=1}^{n}(X_i - \overline{X})^2}\sqrt{\sum_{i=1}^{n}(Y_i - \overline{Y})^2}}, \quad (1)$$

where X_i and Y_i are individual values in X and Y variables; $\overline{X}$ and $\overline{Y}$ are the mean values of X and Y variables [22].

(2) The mean value $\overline{X}$ is the most commonly used measure of centralized trend:

$$\overline{X} = \sum_{i=1}^{N}\frac{X_i}{N}. \quad (2)$$

(3) The standard deviation δ reflects the degree of dispersion among individuals in the group:

$$\delta = \sqrt{\frac{1}{N}\sum_{i=1}^{N}(X_i - \overline{X})^2}. \quad (3)$$

(4) Granger causality test y_t reflects the causal impact of virtual simulation experiment on actual experiment results:

$$y_t = \sum_{i-1}^{q} a_i x_{t-i} + \sum_{j-1}^{q} \beta_j y_{t-i} + u_{1t}, \quad (4)$$

where u_{1t} is white noise.

The dimension reduction processing is implemented for the mined data. The method adopted is mainly component analysis, which mainly reduces the dimension of the data through projection processing to remove the unbalanced data. Set the mined chaotic data object to

$$X = \{X_1, X_2, \ldots, X_m\}, \quad (5)$$

where x represents the chaotic data object mined; X_m represents the constituent elements of the data set; m represents the number of indicators. Linear transformation is applied to the mined chaotic data objects, as shown in the following formula:

$$\begin{Bmatrix} Y_1 \\ Y_2 \\ \cdots \\ Y_m \end{Bmatrix} = \begin{pmatrix} \beta_{11} & \beta_{12} & \cdots & \beta_{1m} \\ \beta_{21} & \beta_{22} & \cdots & \beta_{2m} \\ \cdots & \cdots & \cdots & \cdots \\ \beta_{m1} & \beta_{m2} & \cdots & \beta_{mm} \end{pmatrix} = \begin{pmatrix} X_1 \\ X_2 \\ \cdots \\ X_m \end{pmatrix}, \quad (6)$$

where β_{mm} and Y_m, respectively, represent the feature objects in the chaotic data objects [23], and then let $\beta_i' = (\beta_{i1}, \beta_{i2}, \ldots, \beta_{im}), Y' = (Y_1, Y_2, \ldots, Y_m), Y' = (Y_{1,2}, \ldots, Y_m)$, then $Y' = \beta_i' X$.

When the following constraints are met:

$$\beta_i' Y' = 1. \quad (7)$$

The new p principal components of chaotic data can be obtained to reduce the dimension of data. The kernel function is selected by support vector machine, so as to map the training set samples to a high-dimensional space. In this space, the optimal hyperplane is obtained to get the optimal classification function and realize the efficient classification of chaotic data.

The type of kernel function selected is linear kernel, which is as follows:

$$K(x_1, x_2) = x_1 \otimes x_2, \quad (8)$$

where K represents linear kernel; x_1 and x_2 represent the training set samples. The corresponding classification function is as follows:

$$f(x) = sign\left(\sum_{n=1}^{n} aK(x_1, x_2) + b\right), \quad (9)$$

where $f(x)$ represents the optimal classification function; n stands for normal number; a and b represent the linear thresholds.

4.2. Analysis of Teaching Effect. In order to evaluate the impact of virtual simulation experiment teaching on actual experiment teaching as a whole, four experimental items of combination of virtual and real are selected in this paper, including atomic absorption, liquid chromatography, Bernoulli experiment, and centrifugal pump characteristic curve measurement. Among them, the virtual experiment of atomic absorption and liquid chromatography focuses on process training due to the limitation of development time and does not involve later data processing and mathematical model. The latter two chemical engineering principle experiments not only have detailed steps but also involve more mathematical models, and the process is relatively close to the actual experiment [24]. The analysis results are shown in Figures 5–7.

Figures 5–7 show that the average score of virtual experiment is generally higher than that of practical experiment. After analysis, the reasons are as follows: (1) All students can operate the virtual experimental instrument in person, and their practical ability can be fully trained. (2) The operation steps and test results of the virtual simulation experiment project have been reasonably simplified, which greatly reduces the random factors in the experimental process. (3) The design of some virtual experiment scripts is unreasonable, only orderly operation and error-free operation feedback. The correlation coefficient of virtual experiment shows that the results of simulation experiment with fewer steps and simple operation are weakly correlated or even negatively correlated with the actual experiment. There is a strong positive correlation between the results of virtual experiments with many operation steps and complex principles and the results of practical experiments. This shows that the closer the virtual experiment project design is to the real experiment, the more it can reflect the students' real theoretical learning and operation level.

The standard deviation data show that the standard deviation of most virtual experiments is lower than that of practical experiments, that is, the distribution of students'

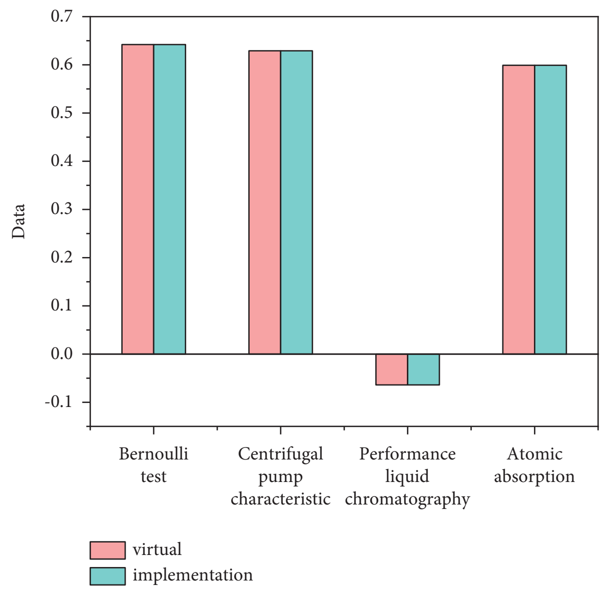

Figure 5: The correlation coefficient of the experimental project combining virtual and real.

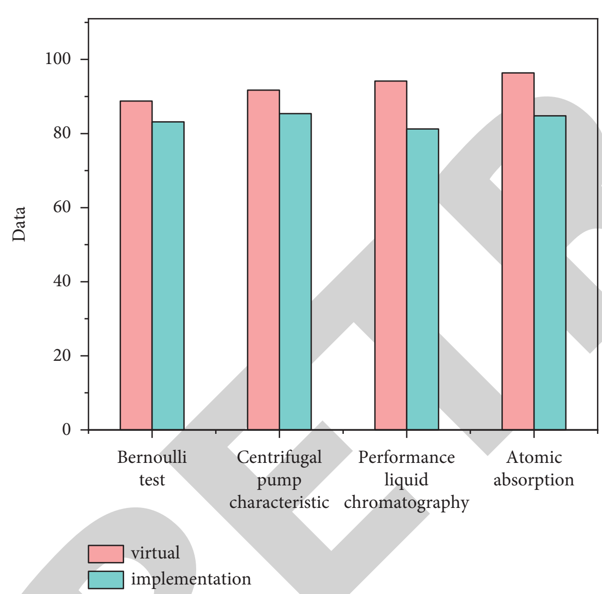

Figure 6: The mean value of the experimental project combining virtual and real.

scores is relatively concentrated. When carrying out the practical experiment with a relative shortage of sets, only the students who are really interested and have a good foundation can get the opportunity of practical operation, and their grades are relatively high. Virtual experiment breaks through the limitation of the number of instruments and the number of operations, can fully cultivate students' ability, and the score distribution is closer. Granger causality test shows that the development of virtual simulation experiment teaching has a significant impact on the improvement of practical experiment results [25].

With the increase of operation times, the experimental results of most students have improved. When the number

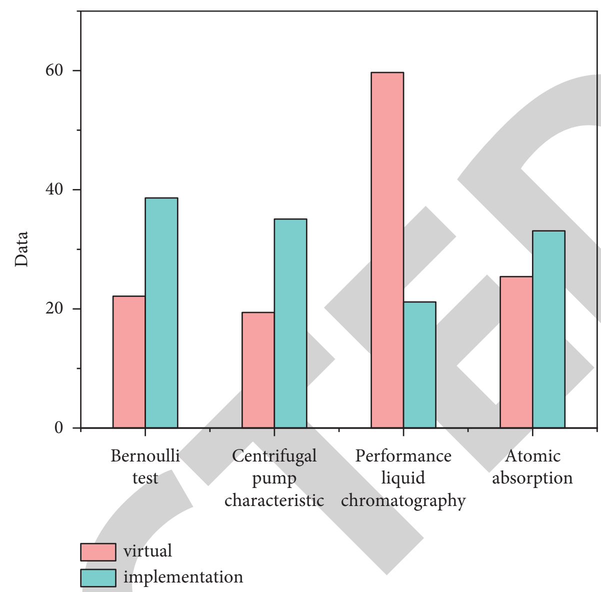

Figure 7: Standard deviation of experimental items combining virtual and real.

of operations reaches 5, most students can accurately grasp the operation steps of liquid chromatography. After more than five times, the improvement of students is not obvious. Compared with liquid chromatography, the improvement of Bernoulli experiment can be divided into two stages: 1–5 times belong to the process improvement stage, and students can master it quickly; 6–12 times belong to the detail improvement stage, and the lifting times are relatively slow. It takes much more time to master it completely than the virtual simulation experiment of liquid chromatography. This shows that the development of virtual simulation experiment teaching resources should not only meet the training of operation process but also pay attention to the cultivation of innovation ability and application ability. In terms of teaching arrangement, different types of experiments need to arrange corresponding practice hours in order to achieve satisfactory training results.

5. Conclusion

This paper finally completes the construction of a general multimedia teaching-assisted learning platform that supports different types of courses, and uses the WeChat public platform and Weibo platform as the medium to promote the assisted learning mode based on PC and mobile intelligent terminals, providing a combination of multiple check-in and roll-call functions, and any time before class. You can preview, test, communicate, and interact at will, and realize one-click forwarding on WeChat and Weibo on the universal integrated platform. Practical statistical data analysis proves that teaching organization through the universal integrated teaching auxiliary platform stimulates students' interest in learning, regulates students' learning order, improves students' participation, improves teaching effect, and improves teaching quality.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

Acknowledgments

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