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Retraction

Retracted: IoT Networks and Digital Twin Technology-Based English Classroom Immersive Teaching

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Security and Communication Networks has retracted the article titled "IoT Networks and Digital Twin Technology-Based English Classroom Immersive Teaching" [1] due to concerns that the peer review process has been compromised.

Following an investigation conducted by the Hindawi Research Integrity team [2], significant concerns were identified with the peer reviewers assigned to this article; the investigation has concluded that the peer review process was compromised. We therefore can no longer trust the peer review process and the article is being retracted with the agreement of the Editorial Board.

The authors disagree to the retraction.

References

[1] Q. Xiong and W. Michalak, "IoT Networks and Digital Twin Technology-Based English Classroom Immersive Teaching," *Security and Communication Networks*, vol. 2022, Article ID 4627972, 11 pages, 2022.
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Research Article

IoT Networks and Digital Twin Technology-Based English Classroom Immersive Teaching

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In order to improve the effect of English classroom teaching, this paper builds an immersive teaching model of English classroom based on IoT networks and digital twin technology. Moreover, in order to reduce the cost of the system, simplify the system structure, and enable learners to observe the stereoscopic display image with the naked eye, this paper builds an immersive hemispherical projection teaching system, designs the overall structure of the system and various components of the hardware, and studies the projection image predistortion algorithm. In addition, this paper uses the immersive experience between virtual reality technology and immersive teaching as a connection point to design an immersive teaching based on VR and apply it to teaching practice to test the effect of immersive teaching, and perfect the immersive teaching design model based on VR. Finally, this paper designs an experiment to verify and analyze the performance of the system. The experimental results show that the English classroom immersive teaching model based on digital twin technology constructed in this paper is effective.

1. Introduction

The rapid development of science and technology has a huge impact on people's production and lifestyle. In order to better adapt to the development of society and their own needs, the improvement of scientific literacy is particularly important. As the main way to improve scientific literacy, science education has become more and more important. Relevant departments have proposed that the reform needs to pay full attention to the vital role of information technology in the development of educational English teaching, accelerate the construction of educational informationization, and add high-quality resources and advanced technology to the current education system to promote the modernization of educational content, English teaching methods. Scientific spirit is one of the core qualities of talent training in the new century, and the study of science courses in colleges and universities is the first step to become scientific and technological talents. At present, China's science education has made a lot of progress in curriculum construction and practice. However, due to many reasons, Chinese science education still has problems in English teaching methods and English teaching content, which hinder the development of science education and the improvement of scientific literacy to a certain extent. Moreover, in the current social environment of rapid development of information technology, these problems are increasingly exposed [1]. Therefore, the use of advanced information technology to improve English teaching methods to make up for the deficiencies in traditional English teaching is becoming the research frontier in the field of educational English teaching. Moreover, the integration of immersive virtual reality technology into college science classrooms can enrich the English teaching situation and improve English teaching methods, thereby stimulating students' interest in learning and improving the quality of educational English teaching [2].

The current science curriculum lacks standard systemicity and completeness, and has high requirements for teachers. Therefore, science classrooms need to create a real

English teaching environment for learners, and use learning resources to stimulate students' interest in learning. The traditional science classroom is mainly based on teachers' PPT courseware and video materials, and the English teaching form is single. It is difficult for students to master abstract scientific knowledge in the classroom, which leads to a decrease in interest in learning [3]. In addition, the smooth development of the experimental inquiry link largely determines the quality of English teaching in science courses, so the lack of experimental equipment is also a major problem in science education. In particular, due to insufficient education funds in remote areas, it is impossible to purchase the basic equipment needed for experiments, resulting in students not being able to experience the fun of scientific knowledge, thereby reducing their interest in learning. Therefore, due to the problems of English teaching methods and English teaching resources in the English teaching process of science courses in universities, the current level of science education in my country's universities is not high, which hinders the development of science education in my country. In order to better develop science courses and improve the shortcomings in traditional English teaching, education researchers gradually try to use new technical means to assist the development of learning activities. Virtual reality technology makes learners feel as if they are in the real world and get a real learning experience through various technical means such as computer three-dimensional technology, interactive technology, man-machine interface technology. The ease of operation of virtual courseware enables teachers to improve the English teaching methods of science courses and enrich courseware resources while effectively increasing students' interest in learning and completing English teaching content more efficiently.

Based on the above analysis, this paper uses digital twin technology to construct an English classroom immersive teaching model, analyzes the corresponding hardware and software structure, and combines experiments to verify it, so as to reform the traditional teaching model and improve the effect of college English teaching.

2. Related Work

Virtual Reality (VR for short) has gradually entered people's daily life and work, and Oculus-based immersive virtual reality has achieved fruitful application results in medical, construction, education, and entertainment applications [4]. In the next 2-3 years, virtual and remote laboratories will be the key technology to solve the contradiction of deep learning [5]. In the field of education and teaching, virtual reality technology breaks the traditional learning methods, enables students to interact with each other in a virtual environment, and makes up for the shortcomings of interactivity, contextuality, and immersion in traditional classrooms [6]. The idea of "virtual reality + education" is being realized step by step, and the new education and teaching mode V-1earning based on virtual reality technology is about to enter people's field of vision. Moreover, virtual reality has been continuously improved and developed in practice since its birth, and its application fields have gradually expanded. At the same time, virtual reality technology in the military, aerospace, and aviation fields can enable trainers to conduct military exercises as if they are in actual combat, thereby improving the ability of coordinated operations [7]. In terms of environmental industrial design and manufacturing, the use of virtual reality technology can provide technical support for various stages of product design and production, and determine the quality and performance of the product in a simulation environment, thereby saving a lot of manpower and material resources [8]. In addition, there are also signs of virtual reality in the entertainment and art fields such as virtual museums and virtual opera houses. With the growing usage of virtual reality technology, educators and academics have started to explore how virtual reality technology might be used to the area of education and teaching. Virtual reality technology, according to current research, may boost learners' learning interest and motivation, as well as their practical operation and inventive thinking abilities [9]. Moreover, the three characteristics of immersion, conception and interactivity of virtual reality technology can enable the experiencer to get the same feeling in the virtual reality environment as the natural environment [10]. The key technology of traditional virtual reality lies in data acquisition technology, modeling sensor technology, interactive technology and tracking technology. However, immersive virtual reality mainly uses environment modeling, stereo synthesis and stereo display technology, and it combines tactile feedback technology and positioning interaction technology in the new era to improve the user's sense of reality and presence [11]. Immersive virtual reality is a derivative of virtual reality technology. Users use virtual devices such as head-mounted displays, data gloves, and trackers to combine visual, auditory, and tactile senses to perform immersive experiences in simulated scenarios [12]. Immersive virtual reality technology can flexibly dispatch all sense organs of the user to interact with virtual objects in a variety of natural ways in real time to make up for the shortcomings in real life [13]. The teaching classroom based on immersive virtual reality technology combines the advantages of mobile learning and digital learning, and fully combines online learning resources and offline classroom teaching. Moreover, the intelligent learning environment it creates can break through the limitations of time and space, and improve the contextuality and intuitiveness of knowledge presentation. The application of immersive virtual reality technology to science curriculum education in colleges and universities aims to explore the characteristics of this teaching mode and give full play to its advantages to help students form scientific cognitive methods and correct scientific views, to enrich classroom learning methods, so as to stimulate students' enthusiasm for learning and develop students' creative potential [14]. In addition, the application of immersive virtual technology and equipment to science classrooms in colleges and universities can effectively solve many problems in the current classroom teaching, so that

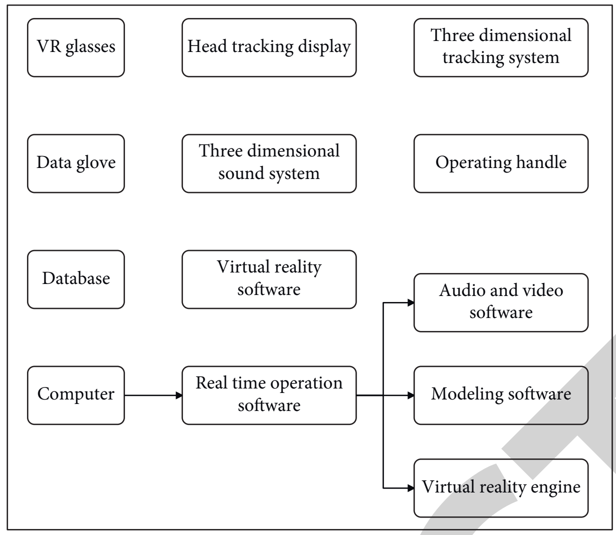

Figure 1: The structure of the immersive virtual reality system.

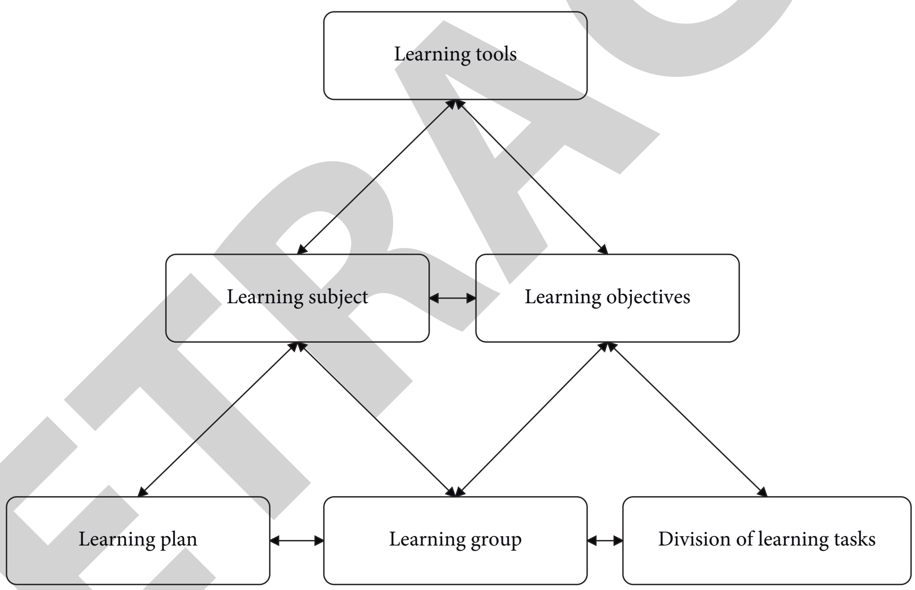

Figure 2: Theoretical structure diagram of learning activities.

students can be immersed in a virtual science environment to intuitively understand scientific phenomena [15].

3. Analysis of Immersive Algorithms Based on IoT Networks and Digital Twin Technology

This article uses English speech sounds to identify students, and introduces the extracted features and classification methods.

We assume that the sample data of English speech sounds is [16]

$$X = \{x_1, x_2, \cdots, x_n\}. \quad (1)$$

Among them, $\{x_1, x_2, \cdots, x_n\} \in R^n$ and $x_i \in R$. The calculation formula for each feature is as follows:

(1) Mean value: it represents the tie level of a certain set of data:

$$\text{Mean} = \frac{1}{N}\sum_{i=1}^{N} x_i. \quad (2)$$

(2) Standard deviation (SD): standard deviation is the arithmetic square root of variance, which can be used to express the degree of dispersion of a set of data.

$$SD = \sqrt{\frac{1}{N}\sum_{i=1}^{N}\left(x_i - \mu\right)^2}. \quad (3)$$

Among them, μ is the mean of the sample.

(3) Coefficient of Variation (CV): the coefficient of variation of a random variable is used to describe the size of the standard deviation relative to the average.

$$CV = \frac{SD}{mean}. \tag{4}$$

(4) Kurtosis: the kurtosis of a random variable describes the height of the peak of the probability density distribution curve at the average value and reflects the sharpness of the peak.

$$\text{Kurtosis} = \frac{1/N \sum_{i=1}^{N} \left(x_i - E(x)\right)^4}{\left(D(x)\right)^4}. \tag{5}$$

(5) Skewness: the skewness of a random variable describes the direction and degree of skewness of the data distribution, and reflects the degree of asymmetry of the data distribution.

$$\text{Skewness} = \frac{1/N \sum_{i=1}^{N} \left(x_i - E(x)\right)^3}{\left(\sqrt{D(x)}\right)^3}. \tag{6}$$

(6) Interquartile range (IQR): it is an important statistical quantity that arranges a set of numbers from small to large, and divides the arranged numbers into four equal parts. The interquartile range is equal to the first quartile value minus the third quartile value [17].

$$IQR = Q_3 - Q_1. \tag{7}$$

Among them, Q_1 is located in the $(n+1)/4$-th number, and Q_3 is located in the $3(n+1)/4$-th number.

(7) Root mean square (RMS): the root mean square of a random variable describes the overall size and average level of the data.

$$RMS = \sqrt{\frac{\sum_{i=1}^{N} x_i^2}{N}}. \tag{8}$$

Since the result of classification is only two types of students and nonstudents, the method used in this paper to identify students is a two-class support vector machine. The essence of SVM is to minimize structural risk and maximize the geometric boundary between classes. Therefore, the larger the boundary, the better the classification effect. SVM has achieved good results in many practical learning problems, and its principles are as follows:

First, we are given a training set [18]:

$$D = \{(x_i, y_i)\}_{i=1}^{N}. \tag{9}$$

Among them, the input is $x_i \in R^d$, and its related output is $y_i \in \{-1, 1\}$. Each output x_i is transformed into a higher-dimensional feature space F through the nonlinear mapping function $\varphi(x)$. If the training sample is linearly separable in a

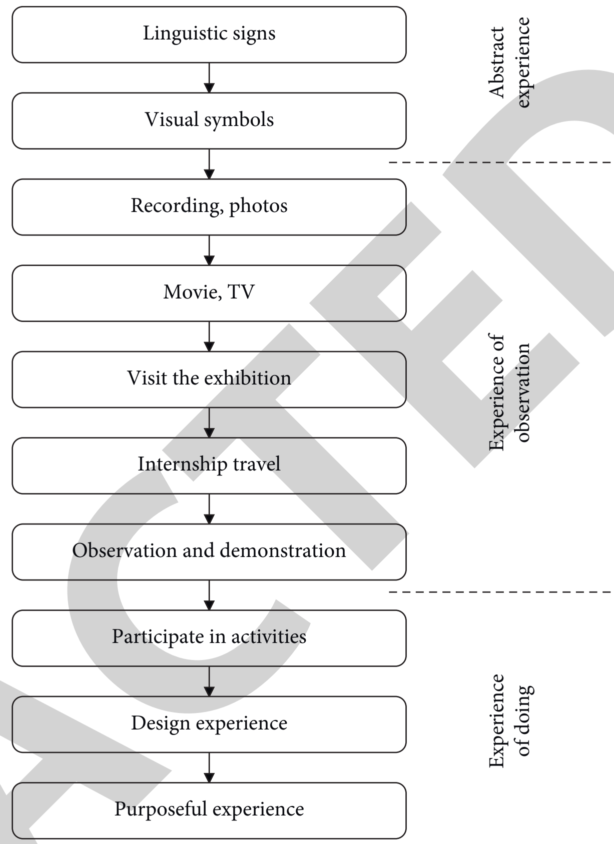

Figure 3: Schematic diagram of the tower of experience.

specific space F, there is a separation hyperplane corresponding to a vector $\omega \in F$ and a scalar ω_0, which is expressed as follows [19]:

$$\begin{gathered} \omega^T \varphi(x) + \omega_0 = 0, \\ y_i\left(\omega^T \varphi(x_i) + \omega_0\right) \geq 1, \forall i. \end{gathered} \tag{10}$$

The separation boundary between the two classes is defined as $2/\|\omega\|$, and the optimal separation hyperplane can be constructed for SVM by maximizing the boundary, that is, minimizing $\omega^T\omega/2$ under the constraints of the formula.

The optimal separating hyperplane is obtained by maximizing a quadratic programming problem, which constructs a Lagrangian formula, and then transforms it into a dual problem [20]:

$$\begin{gathered} W(\alpha) = \sum_{i=1}^{N} \alpha_i - \frac{1}{2} \sum_{i=1}^{N} \sum_{j=1}^{N} \alpha_i \alpha_j y_i y_j \varphi(x_i)^T \varphi(x_j) \lim_{x \longrightarrow \infty}, \\ \sum_{i=1}^{N} y_i a_i = 0, 0 \leq a_i \leq C, \forall i. \end{gathered} \tag{11}$$

Among them, $\alpha = (\alpha_1, \alpha_2, \cdots, \alpha_n)$ is the Lagrangian multiplier and C is the regularization parameter.

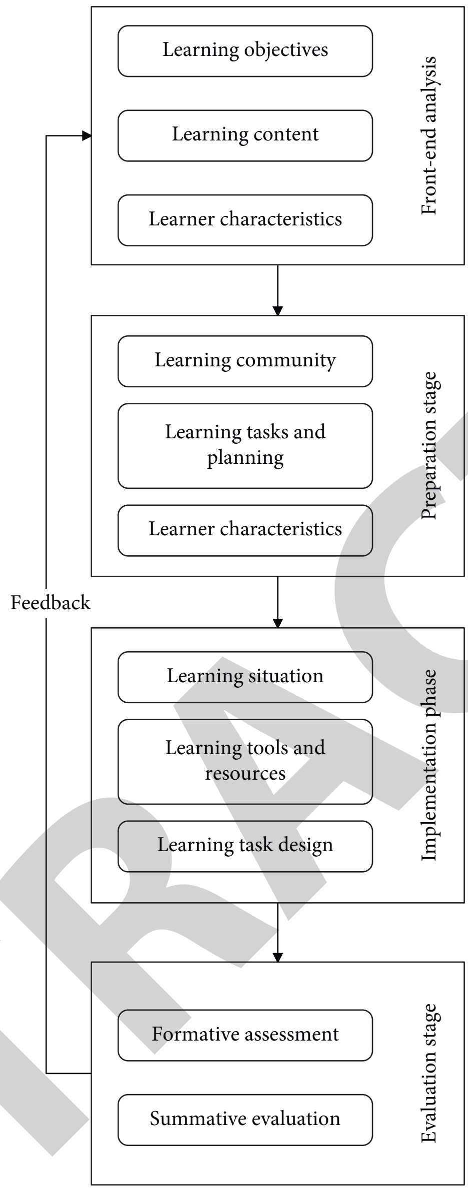

Figure 4: Flow chart of teaching design in virtual reality classroom.

4. Construction of English Classroom Immersive Teaching System Based on IoT Networks and Digital Twin Technology

The immersive virtual reality system mainly refers to the system in which students enter the virtual environment through the use of special equipment during the learning process. As shown in Figure 1, it includes multiple devices [21].

Based on the view of activity theory, the elements in the activity system correspond to the design of learning activities. Figure 2 shows the structure diagram of the learning activity theory [22].

First, the subject of learning in learning activities is the subject of activity theory. Secondly, the learning objectives and learning content formulated according to the syllabus are the object elements in the activity theory. Third, a learning group composed of multiple learning subjects is a group element in activity theory, such as a learning collaboration group, a class, or a family. Fourth, tool components are the learning materials and learning instruments employed by the learning topic throughout the learning process. Fifth, the learning group's cooperation rules match to the theory's rule aspects, such as collaboration and communication rules. Sixth, as part of the division of labor theory, students study task division and role assignment. In addition, the learning activity system should include aspects such as interface design, teaching methodologies, learning feedback, and learning assessment, all of which are specific to learning activities. Each component of the learning activity model should be scientifically and logically placed in a certain sequence to facilitate efficient learning. The front-end analysis stage, teaching preparation stage, implementation stage, and

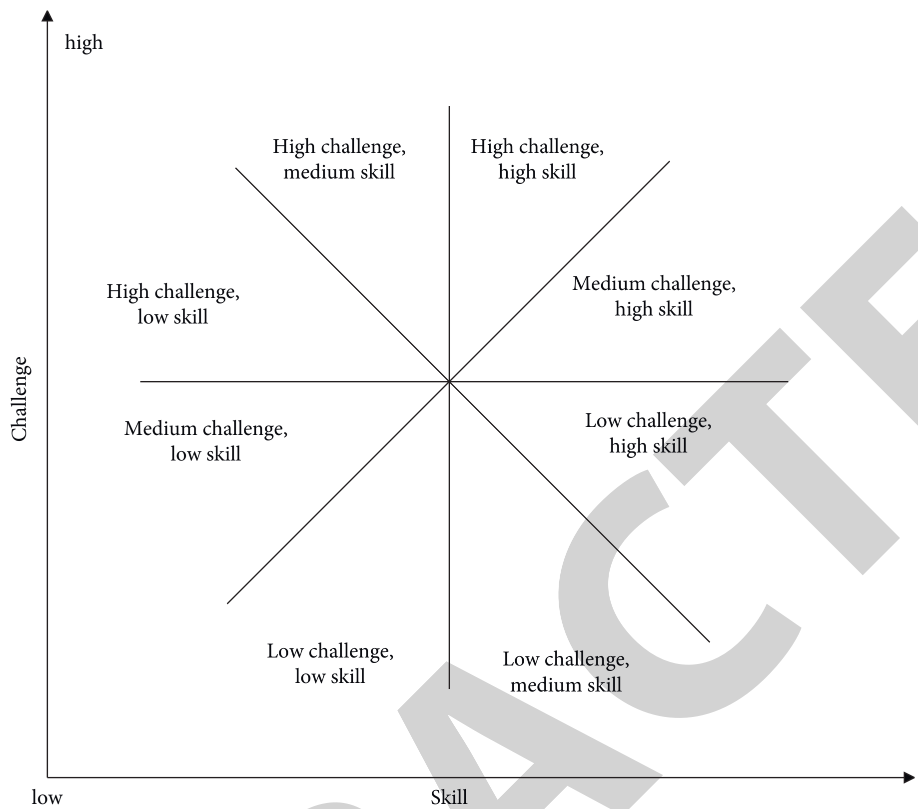

Figure 5: 8 combination relationships of immersive models.

teaching evaluation stage are the four steps of learning activity design.

According to the idea, the concrete experience of action is the most concrete, and it progressively changes to the abstract experience, as illustrated in Figure 3. Various learning experiences are interconnected, and an efficient education and teaching process should include both real and abstract experiences, which may be achieved via the use of instructional media. Dell's Tower of Experience Theory offers suggestions on how to employ network media technology in the classroom and aids in determining the medium's teaching level. The way individuals learn is progressively changing as media technology continues to advance. According to Dell, multimedia technology has yet to be developed in the education sector, therefore today's experience tower is up against a formidable battle. As a result, in the network era, it is required to merge high and new technologies to create a "experience tower." The emergence of immersive virtual reality technology has turned "doing experience" to "abstract experience" into a combination of traditional experience and network experience. Users can experience the "doing experience" through various sense organs such as seeing, hearing, and smelling in a simulated environment based on immersive virtual reality technology. Virtual reality technology is mainly used in teaching practice. Learners can be immersed in virtual teaching situations to simulate internship demonstrations or visit tours to gain "observational experience." The things in the virtual scene are composed of realistic three-dimensional images, which make people feel immersive to observe the things. For abstract experience, virtual technology can create simulated teaching situations and concretize abstract concepts. Moreover, learners can use visual and intuitive simulation information to better obtain "abstract experience" in the learning process. In contrast, traditional teaching media can only provide two-dimensional text or images. However, the science classroom based on virtual reality technology can realize the organic integration of the three concepts in the "Tower of Experience" theory, so that learners can obtain rich sensory experience and optimize the teaching effect.

As shown in Figure 4, immersive virtual reality teaching design mainly includes the front-end stage, preparation stage, implementation stage, and evaluation stage. In the front-end stage of learning, it is mainly to analyze learners and learning content. The learning preparation stage mainly includes the analysis of learning groups, learner characteristics, and learning tasks. The implementation stage is mainly about the teaching situation and learning resources. The learning evaluation stage is a combination of formative evaluation and summative evaluation.

This article builds an immersion model that includes eight combinations of challenges and skills, as shown in Figure 5. Among them, challenges and skills are divided into three levels: high, medium, and low. Moreover, the two are combined into eight relationships: high challenge and high skill, high challenge and medium skill, high challenge and low skill, medium challenge and high skill, medium challenge and low skill, low challenge and high skill, low

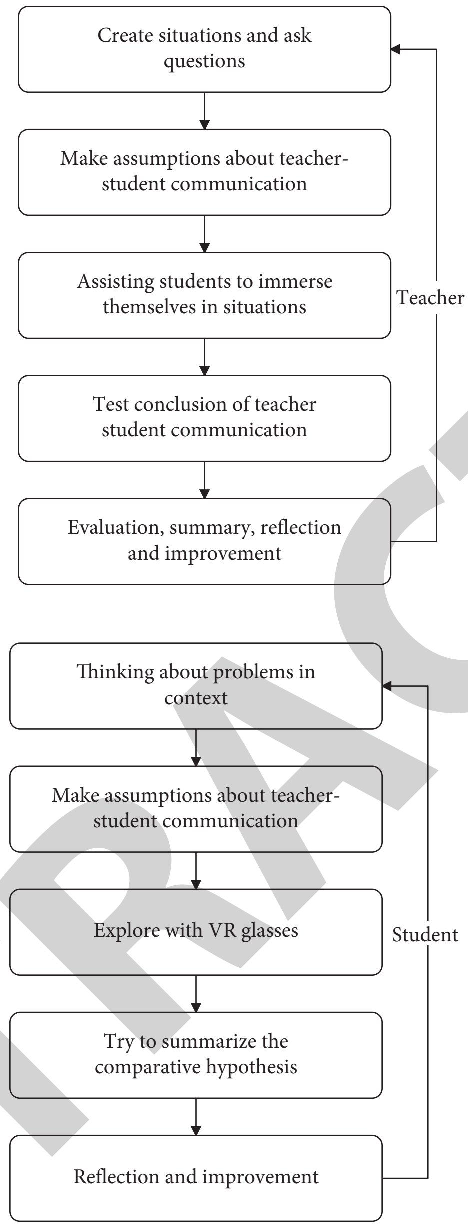

Figure 6: Teacher activity framework and student activity framework.

challenge and medium skill, and low challenge and low skill. Among them, since personal ability is not enough to deal with challenges, high challenges and medium skills, high challenges and low skills, medium challenges and low skills can cause anxiety. Secondly, since the skills mastered by individuals are much higher than the current challenge level, medium challenge and high skill, low challenge and high skill, and low challenge and medium skill will make people bored. Furthermore, low difficulties and poor skills make persons indifferent since personal talents are not great and individuals are not eager to challenge. The model demonstrates that a person enters and sustains a state of immersion known as "flow" only when high difficulties are combined with high talents.

This article refers to the "game immersive teaching model" to design a specific immersive teaching process, which removes game elements and adds elements of VR equipment. The specific teaching process design is divided into teacher activities and student activities. First, teacher activities include five parts: creating situations and asking questions; teacher-student communication and hypotheses; assisting students and immersing situations; teacher-student communication and testing conclusions; evaluation summary and reflecting on improving, as shown in Figure 6. Second, student activities include five parts: entering the situation and thinking about problems; communicating with students and proposing hypotheses; wearing VR glasses and exploring; trying to summarize and contrast hypotheses; reflecting on improving.

VR-based immersive teaching meets the requirements of the new curriculum standard to return the classroom to students. Moreover, VR-based immersive teaching

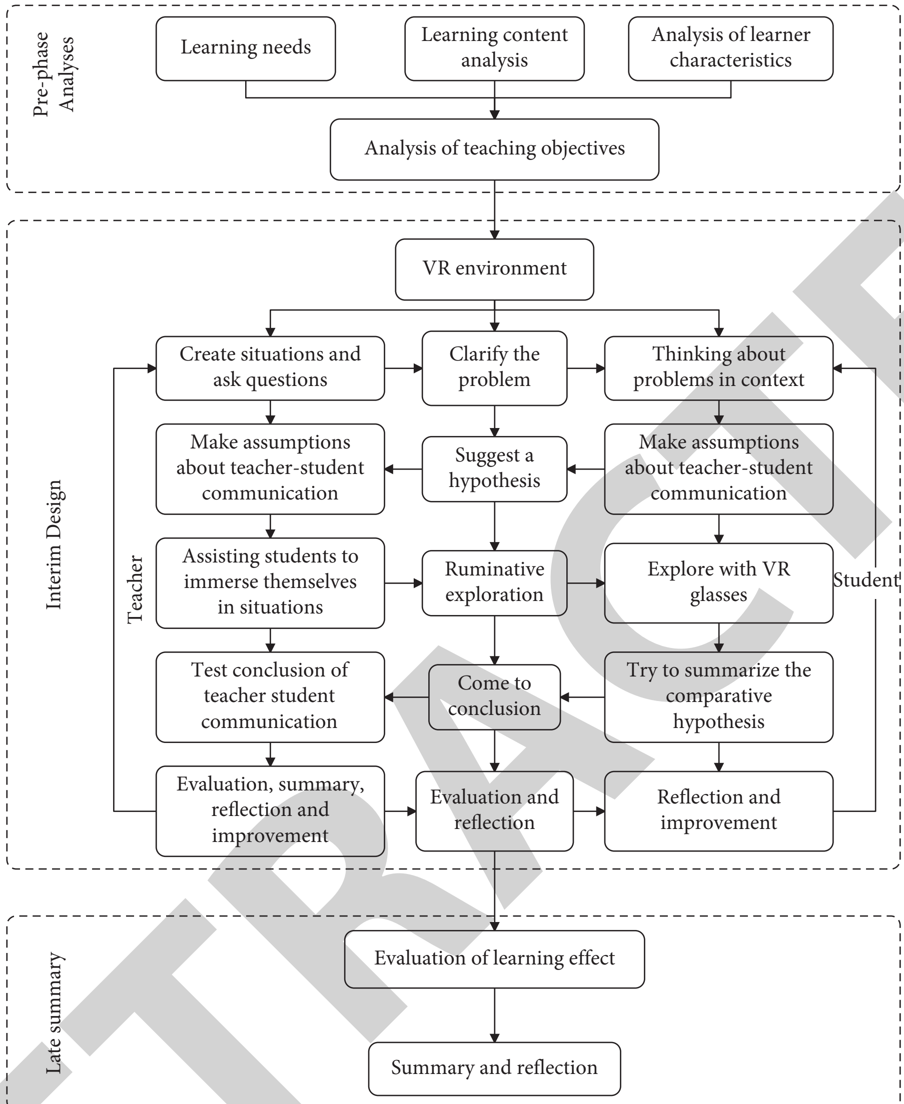

Figure 7: Architecture diagram of English classroom immersive teaching model based on IoT networks and digital twin technology.

emphasizes the model of student-oriented and teacher-assisted, and its instructional design model is based on student activities and teacher-assisted students' meaning construction. The system constructed in this paper is perfected and developed on the basis of the learning-oriented teaching design model, and it fully considers the characteristics of immersive teaching and the reforms that VR technology brings to education. Preanalysis, midterm design, and postevaluation are the three primary modules of the final integrated VR-based immersive instructional design. The preliminary analysis is divided into four sections: assessment of learning requirements, assessment of learning content, assessment of learner characteristics, and assessment of teaching goals. VR teaching environment construction, classroom teaching, instructor activities, and student activities are all part of the midterm design. The latter evaluation is divided into two parts: an assessment of the learning impact and a summary and reflection. Figure 7 depicts the particular model.

5. Evaluation of the Effect of English Classroom Immersive Teaching System Based on IoT Networks and Digital Twin Technology

This paper constructs an English immersive teaching system based on digital twin technology. The system builds a virtual teaching environment based on digital twin technology to enable students to be immersed in the virtual teaching environment. The evaluation of the system effect in this paper is mainly launched from two aspects of system immersion reality and teaching effect. First of all, this paper evaluates the immersive reality of English classroom immersion teaching. It is carried out through experimental teaching methods, and quantitative analysis is carried out based on the scoring method of

Table 1: Statistical table of evaluation of immersion effect of English classroom immersion teaching system based on IoT networks and digital twin technology.

No.	Immersion	No.	Immersion	No.	Immersion
1	92	26	88	51	92
2	90	27	90	52	92
3	88	28	89	53	90
4	89	29	91	54	88
5	89	30	91	55	90
6	93	31	91	56	93
7	91	32	92	57	89
8	92	33	89	58	92
9	90	34	89	59	93
10	89	35	92	60	93
11	89	36	93	61	93
12	88	37	93	62	90
13	90	38	89	63	91
14	90	39	90	64	91
15	91	40	89	65	89
16	91	41	90	66	91
17	89	42	88	67	89
18	90	43	91	68	89
19	92	44	90	69	88
20	90	45	92	70	92
21	91	46	92	71	91
22	92	47	92	72	91
23	93	48	91	73	90
24	89	49	92	74	91
25	89	50	89	75	93

Table 2: Statistical diagram of the evaluation of the teaching effect of the English immersive teaching system based on IoT networks and digital twin technology.

No.	Teaching effect	No.	Teaching effect	No.	Teaching effect
1	82	26	70	51	69
2	90	27	83	52	76
3	73	28	71	53	82
4	86	29	73	54	69
5	77	30	86	55	85
6	79	31	84	56	68
7	90	32	90	57	73
8	78	33	87	58	87
9	87	34	80	59	75
10	78	35	81	60	76
11	81	36	84	61	88
12	85	37	79	62	89
13	74	38	87	63	70
14	69	39	82	64	71
15	86	40	85	65	77
16	70	41	76	66	73
17	90	42	79	67	74
18	79	43	80	68	91
19	81	44	87	69	74
20	75	45	79	70	80
21	73	46	84	71	91
22	82	47	91	72	72
23	83	48	73	73	77
24	90	49	72	74	69
25	73	50	90	75	87

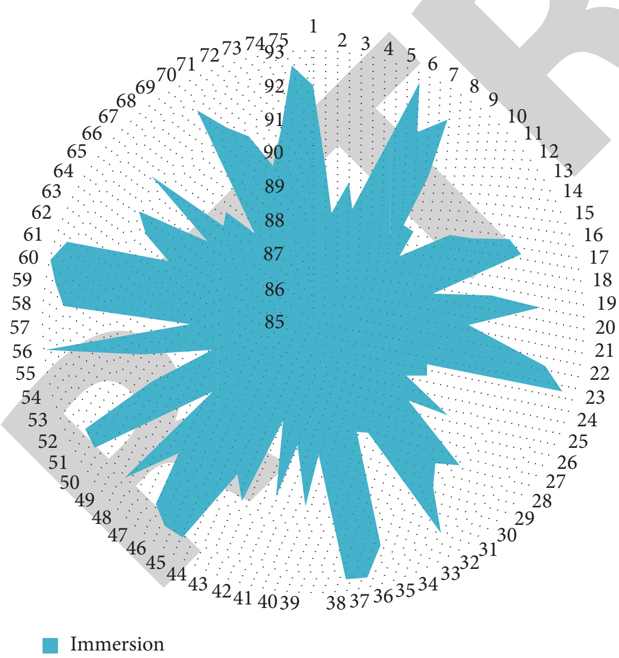

Figure 8: Statistical diagram of evaluation of immersion effect of English classroom immersion teaching system based on IoT networks and digital twin technology.

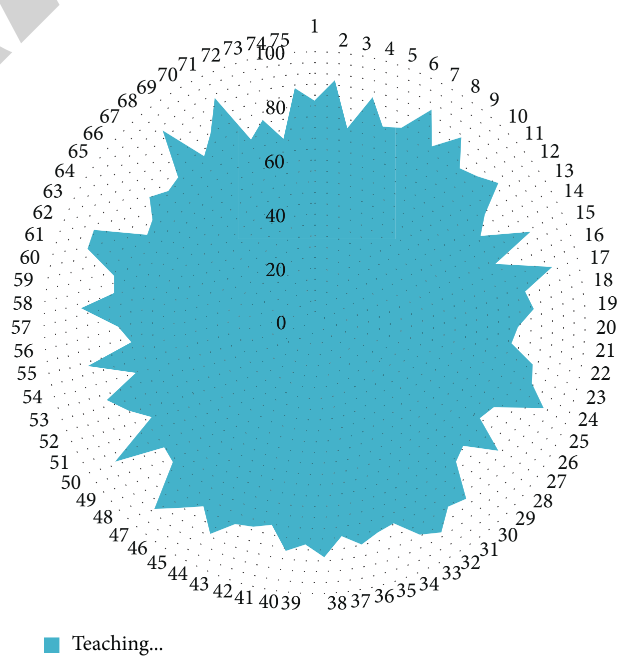

Figure 9: Statistical diagram of the evaluation of the teaching effect of the English immersive teaching system based on digital twin technology.

multiple groups of students, and the results obtained are shown in Table 1 and Figure 8 below.

From the above Figure 8 and Table 1, it can be seen that the English immersive teaching system based on digital twin technology constructed in this paper has a good immersion effect, and students have a reality of teaching content in this teaching system. On this basis, this paper conducts an evaluation of the teaching effect of an English immersive teaching system based on digital twin technology. The results are shown in Table 2 and Figure 9.

The above research results show that the English immersive teaching system based on digital twin technology constructed in this paper can effectively improve the effect of English teaching.

6. Conclusion

This article innovates the traditional English classroom teaching model, analyzes the current situation of immersive teaching and the difficulties in the process of implementing immersive teaching. Moreover, this paper uses the immersive experience between virtual reality technology and immersive teaching as a connection point to carry out immersive teaching design based on VR. In addition, this paper applies it to teaching practice to test the effect of immersive teaching, and perfect the VR-based immersive teaching design model to provide practical and theoretical references for VR-based immersive teaching research. Further, this paper constructs an English immersive teaching system based on digital twin technology. The system builds a virtual teaching environment based on IoT networks and digital twin technology, so that students can be immersed in the virtual teaching environment. After building an English classroom immersive teaching model based on IoT networks and digital twin technology, this paper verifies the performance of the model. From the research results, it can be seen that the system constructed in this paper has a certain effect.

Data Availability

The data used to support the findings of this study are included within the article.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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