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Research Article

Exploration, Analysis, and Practice of Sensor English Teaching Based on Immersive Augmented Reality Technology

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With the continuous development of social economy, English teaching has become one of the inevitable choices of national communication, but how to improve the efficiency and quality of classroom teaching through English teaching is an extremely important research direction. In response to these shortcomings and needs, the immersive augmented reality technology is introduced in this paper. Exploratory analysis of English teaching is performed from various perspectives such as sensor experimental selection, experimental teaching content, sensor progress management, and sensor teaching assessment, through combing the principles and structural framework of sensor technology, to target students and teachers for performing multilevel and multitype analysis and practice, focus on the application analysis of sensors, and highlight manual practice. The simulation experiment results show that the immersive augmented reality technology is effective and can support the exploration, analysis, and practice of sensor English teaching.

1. Introduction

With the continuous development of social economy, English has become one of the important tools for foreign exchanges. Especially after China accession to the WTO, the total volume of foreign trade has also increased year by year, and the frequency of trade has also been rising. As a result, training English talents reasonably and appropriately is extremely important, especially those with professional skills [1, 2]. With the continuous improvement and development of artificial intelligence and other technologies, sensors and other technologies have become one of the important information support technologies, especially as one of the required courses for colleges and universities such as electromechanical and electronic information [3]. At present, most sensor teaching is often based on the superior disciplines or key disciplines of their own college. Therefore, although the relevant knowledge and basic theories of sensors are covered, there are still certain defects and biases. On the one hand, traditional sensor courses mainly focus on explaining the basic theoretical knowledge and related applications of various sensors, but on the other hand, due to the lack of better practical courses for assistance, it is difficult for students to have sufficient perceptual knowledge and sensory cognition [4, 5].

For such traditional teaching, students may not be able to perceive the actual sensor changes and work, so they cannot fully and comprehensively reflect the teaching effectiveness of students mastering the sensor [6]. In the meantime, it should be noted that it is necessary to carry out actual classroom teaching experiments to assess students' hands-on operation ability, master the characteristics of sensors, and analyze the needs for practical applications. Experimental teaching is to provide students with a fixed bridge and framework for the connection between theory and practice. Through technical applications, innovative abilities, and analysis, the main categories can include the following: basic experiments, comprehensive experiments, and experiments orientating at specific goals. Through reformed experimental teaching, students' independent scientific research and practical ability and independent innovation ability can be cultivated [7]. At present, the purpose of practical teaching is mainly close to basic experiments and comprehensive experimental teaching, often focusing on experiments with

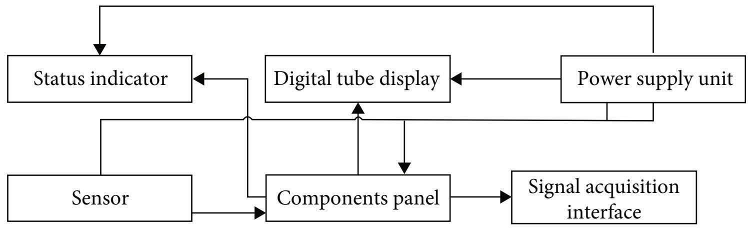

Figure 1: Block diagram of the sensor design experimental platform.

specific goals instead of exploratory and innovative experiments. Therefore, in view of these needs and deficiencies, based on immersive augmented reality technology, English teaching performed in the sensor experiment teaching content, experiment teaching management, experiment management assessment, and other methods is analyzed through combing the principles and structural framework of sensor technology in this paper. The corresponding sensor interface circuit overlap is completed independently through the design of the sensor test bench, to realize the training of the teaching content, aiming at improving the quality and efficiency of teaching.

2. Sensor Design Experiment Platform

Sensor-related equipment can mainly involve multiple sensor types such as capacitive, voltage, pyroelectric, piezoelectric, photoelectric, electromagnetic, and mechanical formation. In order to further enhance the understanding and analysis of the sensor course, train specific practical applications and practical analysis, the corresponding sensor design experiment framework is designed, as shown in Figure 1, it can be composed of components, digital tubes, status lights, signal acquisition, power supply, etc.

During the actual teaching experiment process, you can select multiple types of sensors such as temperature sensors, magnetoelectric sensors, photoelectric sensors, eddy current sensors, and piezoelectric sensors, for measurement and qualitative measurement of multiple indicators such as temperature, displacement, and rotation speed. These corresponding parameters have the advantages of multiple quantitative and multiple measurement methods [8, 9].

Display and process are performed by setting the corresponding output signal. After the corresponding output signal processing, the signal collection interface can import to the corresponding computer for collection and carry out the analysis through the comprehensive use of sensor technology, circuit simulation technology, and digital circuit capabilities, so that students can effectively master the application characteristics of the sensor.

3. Initial Preparations for Bilingual Classes

During the process of English sensor teaching, first of all, it is necessary to determine the textbook and teaching content. Without increasing the burden of the students' schoolwork, it can neither reduce the specific requirements nor affect students' knowledge and mastery of sensor information and experiment based on the current number of teaching hours. At the same time, in the course of teaching and learning, students need to use English to think and solve problems for cultivate bilingual thinking. Therefore, it is extremely important to choose a suitable teaching method.

4. Discussion

In the classroom practice teaching process, teachers need to make full use of existing comprehensive technology, while relying on other teaching methods to make students master the key points and difficulties of the course and fully encourage students to actively participate in practical discussions [10, 11]. During the actual process, groups are formed for discussion and analysis for each classroom teaching, to focus on the content and specific knowledge points needed in the classroom to explain and analyze. In the process of questioning, students use English for questions and discussions, and finally, a student uses English for summarizing answers and analysis.

Through effective English discussion and analysis and reporting, students can effectively improve their expression skills and exercise their English and communication skills. In the actual application process, master more solid knowledge.

The discussion outside the classroom is the homework outside the classroom, which is usually directed by the teacher according to the specific teaching content and the development frontier of the sensor. The students choose the specific tasks according to the direction and knowledge points of their own interest, and through consulting the English literature, conduct group discussions, form free views, and carry out specific discussions. This method can not only promote students to independently consult specific related materials but also understand the frontier theoretical development of sensors in a timely manner. Meanwhile, it can effectively improve students' English reading, writing, and communication skills [12].

5. Performance Assessment and Assessment

This discussion-style and active teaching method helps to improve students' ability to learn, innovate, and create and to shape their ability in a timely manner. It has strong guidance and assessment for the motivation and habits of learning. In terms of performance evaluation, scores can be assigned to students according to their individual performance based on specific performance and the

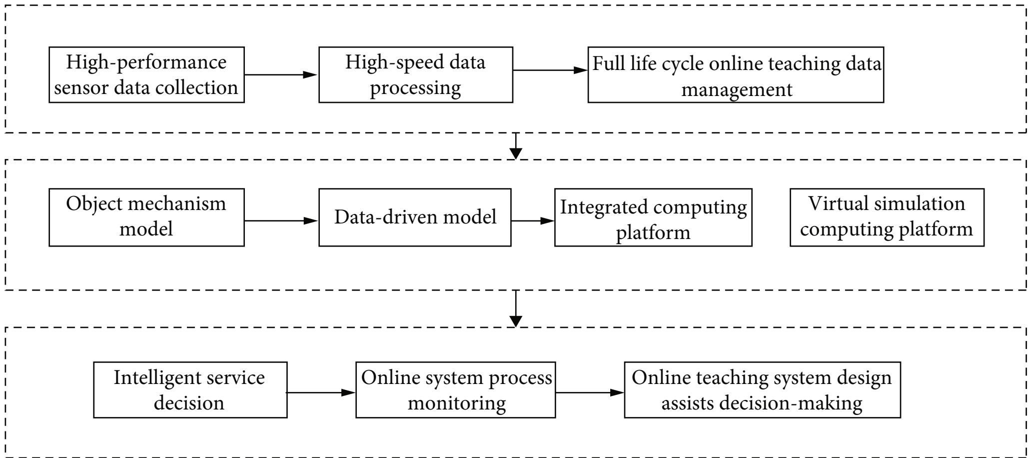

Figure 2: Online immersive teaching system based on digital twin platform.

comprehensive evaluation of final paper test score and graded according to their own performance, analysis of their achievement is performed for everyone. The usual performance assessment can be divided into three parts. One is the performance of students in the classroom, such as the students' initiative to participate in class answers, especially the understanding and preparation of questions; the second is the main discussion outside the class, focusing on the parts. One depth and breadth of understanding in the corresponding direction through assessing ability of each person in the organization and group, facilitate the mutual evaluation between members and show the corresponding problems; the third is the assessment of members between group members; and the final assessment is that the student takes the corresponding final exam.

Through the implementation of group discussion on English teaching, it is first necessary to build a team of bilingual teaching teachers. Meanwhile, under the premise of ensuring the teaching content and teaching tasks, ensure the core content of the teaching materials is focused on and the quality of teaching is deepened. Through group-style discussion teaching methods, the traditional thinking communication between teachers and students is changed to ensure the proactive and creative analysis and display of students. At the same time, to further unite and think, English is used for sensor learning communication and writing analysis. In the meantime, the group-based teaching method can also enable teachers to further understand their theoretical level and teaching ability, especially in the teaching process, can make teachers become guides and analysts, promote, and improve each other.

6. Immersive Augmented Reality Technology

On the basis of the previous research and the basis of immersive augmented reality technology, the digital twin technology can be introduced for applying to online teaching to try to build a digital twin platform. The online immersive augmented reality teaching system can be divided into data support layer, modeling simulation layer, function layer, and immersive augmented reality layer from the basic data layer to the application layer. These four levels are closely related and clearly demarcated. Each level is an enhancement and enrichment of the previous level.

7. Data Support Layer

The data support layer is inseparable from the interaction between the perception of the Internet of Things and the virtuality or truth. Therefore, the construction of a teaching system based on immersive augmented reality technology requires the combination of virtuality and reality, using global sensing equipment, including corresponding cameras and smart watches, data collection and data capture can be realized as well as accurate mapping between virtuality and reality teaching. The data support layer is the key to realizing concrete three-dimensional perception and is the foundation of the immersive teaching system (Figure 2).

(1) In the high-performance sensor data collection, the analysis of computational emotion models can be carried out through wearable devices, such as students' smart bracelets, which can track students' movement, heartbeat, trajectory, and other data through specific APP; in the meantime, through corresponding computer cameras, cameras and other equipment are collected, to carry out the analysis of data of students' facial expressions and body. By means of the data of the intelligent perception system, the analysis of the teaching space is realized through intelligent reading and writing. Meanwhile, the connector of the teaching space in the digital twin platform is used to lay the foundation of global intelligence and immersive teaching

(2) The high-speed data transmission part, based on high-bandwidth optical fiber technology, transmits data such as expressions and limbs to the teacher in real time

(3) The online teaching data management part of the whole life cycle provides technical guarantee for data storage and management

Table 1: The design experiment of the sensor.

Measurement	Content
Temperature	Design PT100 or AD590 sensor circuit for temperature measurement, LED display, overlimit alarm, and calibration
Displacement	Design capacitive, eddy current, and ultrasonic sensor circuits for displacement measurement, LED display, overlimit alarm, and calibration
Stress	Design flexible thin film stress sensor circuit, carry out stress measurement, LED display, overlimit alarm, and calibration
Vibration	Design piezoelectric sensor circuit for vibration acceleration measurement, LED display, overlimit alarm, and calibration
Rotating speed	Design the photoelectric sensor circuit to measure the rotation speed of the rotating body, LED display, overlimit alarm, and calibration
Magnetic field	Design the magnetoelectric sensor circuit to measure the magnetic field strength, LED display, overlimit alarm, and calibration

8. Modeling Calculation Simulation Layer

The actual computational modeling and simulation ability is the reality of the digital twin, that is, the key to realize value through modeling and simulation technology. Modeling and simulation can be composed of three parts: specific modeling methods, computing platforms, and virtual reality simulation technology. Modeling and computing algorithms and platforms can be used for real-time modeling, and virtual simulation technology platforms are mainly used for fusion and analysis of virtual reality and simulation modeling.

The so-called modeling algorithm refers to the effective identification, modeling, extraction, and analysis of the data characteristics of the teaching system based on the existing AI technology, and that diversified and multiscale methods are used to conduct the diversified, multilevel, multiscale data analysis of data provided by data support layer, discriminate the main features and the corresponding logical relationship through data mining technology, achieve the modeling and characterization of the sensor teaching system, and truly make the immersive augmented reality technology carry out teacher-driven decision-making analysis.

9. Functional Layer

Therefore, the digital twin platform is essentially a mapping of the virtual teaching space, which is mainly expanded from three dimensions:

(1) The virtual teaching space and the display teaching space being mapped can diversify, dynamically and visually present the real state of the actual teaching space. (2) The integrated description and analysis of the student's state and environment can realize the student online learning and visual realism of the environment. (3) Through the technology of big data visualization, the diversified, dynamic, and intelligent presentation of scenes can be realized, and the mapping and analysis of actual teaching and virtual teaching can be realized

The functional layer mainly realizes the integration, decision-making, and analysis of online immersive teaching and dynamic reality [13, 14]. Aiming at different sensor teaching systems, immersive augmented reality technology provides intelligent service decision analysis with different real time, coordination and reliability, to further intelligently perfect the virtual teaching space, improve and even reshape the actual teaching space, and realize precise teaching and precise management.

10. Immersive Experience Layer

The key to the online immersive teaching system is to allow students to experience an immersive virtual reality in terms of visual and auditory perception. The experience layer of immersive augmented reality technology is the key to online immersive teaching. It orientates at the teachers and students as audience, with interactivity, fidelity, and creativity as the main reference indicators. The immersive experience layer is mainly to conduct interactive analysis through user, so that users can obtain an actual sensory experience, which can be expanded from three dimensions:

(1) Teachers can achieve a comprehensive and three-dimensional display of the overall view of the sensor teaching space by means of big data and other technologies. (2) Students can enable teachers to better understand the growth of students and the process of learning by means of the corresponding platform. (3) Teachers can comprehensively use the big data for comprehensive modeling, simulation, visualization, and other technologies to realize immersive augmented reality analysis and highly visualized scenes

11. Experimental Results and Analysis

11.1. Experiment Procedure

11.1.1. Selected Subjects of Experiments. The choice of sensor experiment directly determines the effectiveness and quality of teaching. As the key to the entire experiment, it should not only reflect the corresponding teaching content and promote the cultivation of innovation ability but also control the corresponding acceptance ability and difficulty, to encourage students to be interested in learning the corresponding sensor technology. The corresponding experimental teaching is chosen in this paper, that is, on the basis of sensor theory teaching, the basic courses of sensor analog circuit and digital circuit are completed, and practical ability is trained, and knowledge structure is consolidated through experiments in the design department. Table 1 shows the design experiment content of the sensor.

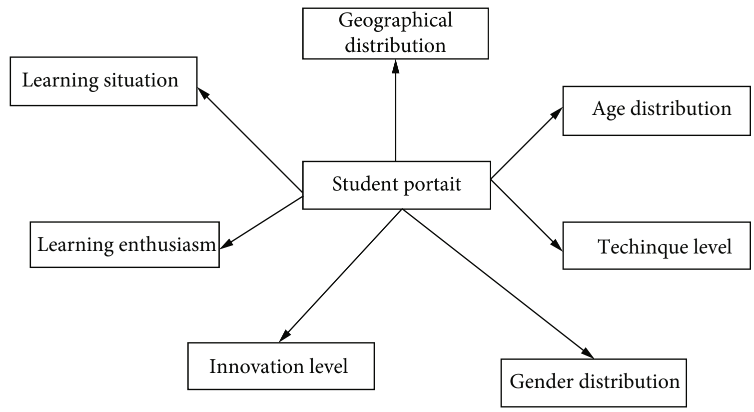

Figure 3: Student portrait model based on user portrait technology.

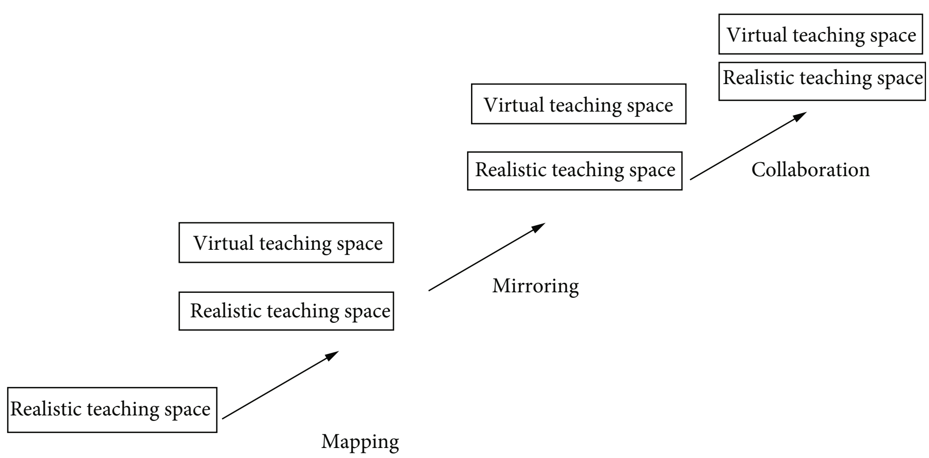

Figure 4: The mapping, mirroring, and collaborative operation framework of actual teaching space and virtual teaching space.

11.1.2. Content of Courses. In the experimental teaching of the Department of Design, the specific tasks are done independently by the students with students as the corresponding leaders and the teachers as the assistants. It should be noted that since students have not participated in similar experimental classes before, teachers need to inform them of basic experimental skills to ensure the safety of experiments and improve students' hands-on ability [15–17]. The specific teaching content mainly includes the following: Research on literature, that is, carrying out the query of data and literature according to the specific direction, provision of design plans of the sensor signal amplification, filtering, and others; the software development, the adjustment and improvement of the sensor circuit by means of specific software for simulation analysis; the use of the equipment, the use of the corresponding universal meter and components and parts for analysis of debugging tools; lap debugging, lap the corresponding electronic components, inspire students to find questions and corresponding answers, avoid direct operation by teachers, and encourage independent completion; index testing, specific calibration test for sensor circuits through fixed calibration equipment, realizes the calculation and analysis of accuracy and stability through data recording and writes specific experimental reports.

11.1.3. Progress Management. According to the content and schedule of the course, the experimental course is set for 2-3 weeks, but it should be noted that due to the equipment debugging process of the experimental class, various problems may be encountered, such as typical damage, improper use, and wiring errors of components and parts. In the actual operation process, there are still students who fail to master all the functions. Therefore, in view of such a situation, teachers must make appropriate adjustments and management of the specific process, carefully listen to the students' demonstration of the program, and give specific explanations to the concentrated issues to achieve the necessary inspiration.

The teacher will determine the final score based on factors such as student attendance, circuit debugging, experimental results, defense situation, and experimental report, in order to comprehensively test the students' mastery of sensor technology.

11.1.4. Assessment Form. The course experiment focuses on cultivating students' ability to analyze and solve problems through hands-on practice. While emphasizing the results of the experiment, they also pay attention to the whole process of participating in the experiment [18–20]. Therefore, after

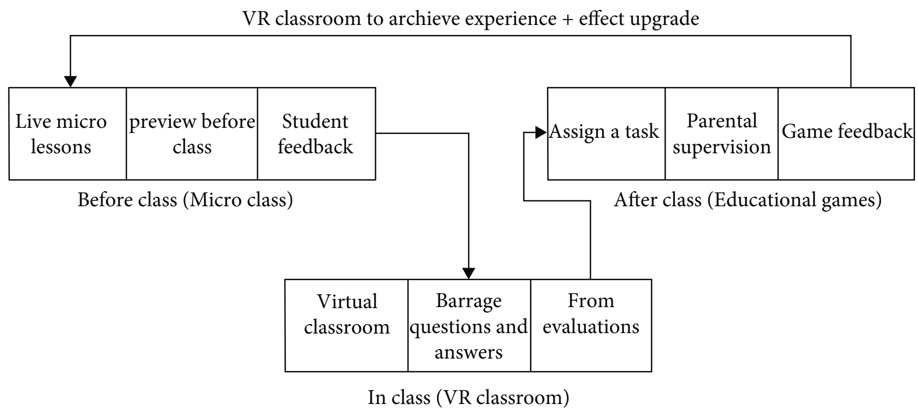

FIGURE 5: Design of teaching process.

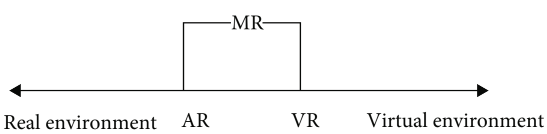

FIGURE 6: Differences and connections among the three technologies of VR, AR, and MR.

completing the experiment, the students will respond to the test results, the problems, and the key technologies in the experiment and submit the experiment report at the same time. The teacher will determine the final score based on factors such as student attendance, circuit debugging, experimental results, defense situation, and experimental report, in order to comprehensively test the students' mastery of sensor technology.

11.1.5. Teaching Analysis. The laboratory is the most important platform for quality education for students, and experimental teaching provides important training conditions for undergraduates to enter the laboratory in the future. Designed experiment is the highest level of experimental teaching, which belongs to the reform of experimental teaching methods [21, 22]. The designed sensor courses make full use of the existing resources of the laboratory to improve the utilization rate of equipment, so that those students who have the ability to learn can carry out research and innovation on this platform. Through the open experimental teaching environment that has been created, students cultivate practical and innovative abilities in the scientific research training program (SRTP) and the "Feng Ru Cup" scientific and technological activity competition research. Through the gradual establishment of a student-centered and teacher-led teaching model of theoretical teaching, practical teaching, independent research, and network-assisted learning, students will be motivated to learn sensors, guide them to carry out scientific research and practice of sensor technology, consolidate in practice, and enrich sensor knowledge. Combining a complete set of high-quality textbooks, a hierarchical experimental teaching system, and an open comprehensive experimental platform, the "Sensor Technology and Application" course has been approved for the 2009 Beijing Higher Education Excellent Course.

11.1.6. Teaching Data Analysis and Modeling Based on Multidimensional Analysis. The multidimensional data analysis in the sensor English teaching experiment course can be divided into learning feature analysis and mining, modeling, and simulation of the fusion of virtual and actual teaching space [23, 24].

(1) Analysis and Excavation Online Learning Features. The experimental course uses data feature recognition, data analysis, data analysis and mining, data association analysis to build a student portrait model based on user portraits, and student behavior data (as shown in Figure 3).

(2) Modeling and Simulation of the Fusion of Virtual and Actual Teaching Space. In view of the modeling and simulation of the fusion of virtual and actual teaching space, it mainly collects specific teaching content through the extraction of the characteristics of the online teaching space and key phrases, labels and extracts the elements of the actual teaching space, and builds and analyzes model features using machine learning methods.

11.1.7. Data Application Based on Precise Teaching and Precise Management. The fusion application of virtual and actual teaching space is developed around the interconnection and cofusion of the actual teaching space and the virtual teaching space. It is to realize the mapping, mirroring, and collaboration of the virtual and actual teaching space. The specific operation framework is shown in Figure 4.

11.1.8. Online Immersive Teaching Experience Based on Augmented Reality Technology

(1) Innovation of Online Learning Features. From the perspective of technical characteristics and technical applications, the three technologies of VR, AR, and MR all try to break through and dilute the virtual learning space and the actual physical space and strive to create a simulation or actual learning environment close to social reality, highlighting the interactivity, authenticity, contextualization, and individualization of the learning process and enabling learners to enhance learning interest and enhance learning effects through multimodal learning (Figure 5) [25, 26].

The difference and connection of the three technologies of VR, AR, and MR are shown in Figure 6. It can be seen that in terms of function, MR > AR + VR, that is, MR technology is the integration and upgrade of AR, VR technology, and its equipment.

(1) Before class, students use the VR platform to extract the corresponding video materials and preview test questions from the cloud system for learning. The teacher will explain the key points and difficulties of teaching based on the test scores and problem sets submitted by the students, and a detailed description is provided for the problem, which can improve the efficiency of lectures and adjust to the needs, so it can greatly improve the learning enthusiasm of students

(2) In the classroom, through using interactive platform software, students can construct virtual foreign environments, such as cafes, airports, libraries, and tourist destinations and interact and communicate in the virtual environment in order to improve students' practical English application ability and communication ability. The teachers and students realize voice communication and barrage interaction through the communication system in the virtual classroom, and the data transmission network based on the 5G system satisfies the need in large quantity and small delay for cloud data upload and data sharing

Each area has the same number of N' = N/M nodes, and a total of N English sensor corpus nodes are deployed on the entire square area. Although there are many other possible ways to deploy modules, the purpose is to reveal the relationship between performance and geometric distance.

$$\mathrm{SIMW}(x, y) = \mathrm{SIM}(x, y) \times \mathrm{WeightFactor}(y). \quad (1)$$

Of which

$$\mathrm{WeightFactor}(y) = \sqrt{\frac{\mathrm{freq}(y)}{N_y}}. \quad (2)$$

In formula (2), WeightFactor (y) is the weight of word y; freq (y) refers to the number of occurrences of y in the selected document; N_y represents the number of occurrences of word y in all documents in the entire corpus.

(2) Integration and Innovation of Virtual and Actual Teaching Space. The integration and innovation of virtual and actual teaching space is mainly realized through the integration and innovation of various perceptions and experiences, using three-dimensional virtual modeling and mapping technology, augmented reality technology, etc., to present the digital virtual teaching space to teachers and students [25, 26].

11.2. Analysis of Teaching Effect. After setting up the corresponding experimental courses, the effect of using online research for platform teaching is carried out through student questionnaires and enterprise questionnaires.

Through survey summary and statistics, the experimental courses show that traditional teaching tends to spend too much energy without getting better results. On the contrary, immersive augmented reality technology effectively improves students' subjective initiative and enthusiasm and actively guides students to study in-depth the principle of the sensor, to realize active exploration and innovation.

12. Conclusions

With the continuous development of social economy, English teaching has become one of the inevitable choices of national communication, but how to improve the efficiency and quality of classroom teaching through English teaching is an extremely important research direction. On the basis of theoretical teaching, designing experimental teaching is conducive to cultivating students' ability to integrate theory with practice, comprehensively apply sensor technology and circuit technology and hands-on practice and innovation. In view of these shortcomings and needs, based on immersive augmented reality technology, sensor course practice training is performed through "document research, program design, circuit debugging, index testing, comprehensive analysis," combined with multilevel, multitype analysis and practice, focusing on the actual application scenarios of sensors, while improving students' hands-on ability, further motivating students to be independent, active in innovation and initiative. The simulation experiment results show that the immersive augmented reality technology is effective and can support the exploration, analysis, and practice of sensor English teaching.

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 no conflicts of interest.

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