Influence of an Immersive Virtual Environment on Learning Effect and Learning Experience

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Abstract—To explore the influence of the immersive virtual environment on the learning process of students, it is necessary to analyze the learning effect and learning experience. The immersive virtual environment provides a new idea for education, changes the traditional teaching mode, adds an immersive experience in the teaching process, and increases the participation and fun of students in the classroom. The learning effect and learning experience were analyzed, the positive effect of the immersive virtual environment on students was verified, and the influence of the immersive virtual environment on learning effect and learning experience was explored. Results indicate that the comprehensive score of teaching effect obtained by students with the research method is higher than that before the use of the research method, before using research methods, the average score of students is 84.7, and the average score of students in the experimental class after adopting the method in this study and one month of learning increases by 10 points. The immersive virtual environment has a positive effect on the learning effect and learning experience of students in each discipline.

Keywords—immersive virtual environment, learning effect, learning experience, interesting, contextual

1 Introduction

In the current society talent training involves considerably high requirements as talents are required to be developed in a well-rounded manner and should include the ability to think independently and innovate [1]. With the development of the Internet, the application of immersive virtual environments has been gradually developed and popularized in the field of education and teaching [2, 3]. Its popular use has made it increasingly important to study and design how immersive virtual environments can be used to more efficiently carry out the reform of learning effect and learning experience [4]. The teaching mode in the immersive virtual environment is the learning method that involves cooperation between teachers and students, asking questions, answering questions, making conclusions, and so on. Students can master teaching content and deepen their understanding, cultivate talents with innovative abilities in the new century, and eliminate the boring shortcomings of the traditional teaching mode.

The infusion learning method is a traditional learning method but immersive virtual learning has changed the teaching method of teachers and parents through words and deeds [5]. In this method, the learning environment and learning resources are designed according to the requirements of students so that they can learn knowledge in an immersive virtual environment. The immersive virtual learning environment is characterized by liberalization, contextualization, and virtualization, which makes it easier for students to absorb knowledge [6]. Schools can stimulate and mobilize the learning interest and motivation of students in a happy atmosphere through learning courses in an immersive virtual environment, which can strengthen their autonomy and develop their awareness of innovation.

Immersive virtual environment learning is a reform of learning style and an attempt. Its application in training and teaching has achieved good results through continuous improvement and development, which has improved the status of learning at various levels of training and education. Immersive virtual environment learning has been widely used in training institutions and schools. The design development mode, evaluation mode, and educational value of the immersive virtual learning environment are the main contents of the national research. Scholars have continuously explored the learning process in the immersive virtual environment, which involves a wide range from non-immersive to immersive learning, from effect evaluation to process design, and from specific application to theoretical analysis. It is an urgent problem that needs to be addressed in China and involves the exploration of the learning process to understand the influence of immersive virtual environment on learning effect and learning experience and obtain feasible conclusions.

2 Literature review

Omar et al. [7] explored the influence of college students' learning experiences on e-learning during the COVID-19 pandemic. A total of 68 informed undergraduates and postgraduates from the University Putra Malaysia participated in the case study. They were asked to share their learning experiences through open-ended questions distributed by an online data collection platform called "JotForm". The thematic analysis method was used to analyze the narrative response. Five themes emerged in the narrative analysis: institutional support, emotional engagement, cognitive engagement, behavioral engagement, and student satisfaction. The study found that reinforced the urgent call for a reliable Internet connection to facilitate the online teaching process. The deadly epidemic continues to spread unabated around the world, but education must continue at all levels. Therefore, appropriate measures must be taken to facilitate the teaching process of learners. Zhou et al. [8] proposed that English teaching from the perspective of mediated learning experience aims to explore what English teachers can do to promote English learning from Fierstein's mediated learning experience theory and find a way to compensate for the deficiencies in English teaching. An exploration of Fierstein's educational thought indicates that it challenges traditional education and brings some innovations to education. It believes that meditating is a key factor for effective learning and put forwards dynamic assessment tools. Demillard et al. [9] proposed strategies for students to optimize their learning experience in the

virtual patient care environment and described the challenges of the COVID-19 pandemic to pharmacy education and successfully provide strategies for students in virtual introduction or advanced pharmacy practice experiences. Kamber et al. [10] proposed obtaining personalized distance learning experience through virtual oral examination in undergraduate biochemistry courses. The in-person interaction between teachers and students personalized the learning experience, which is the hallmark of major undergraduate institutions. These valuable teacher-student interactions were disrupted during the outbreak of the COVID-19 pandemic, leading to a rapid and unprecedented shift toward distance learning. Within the space of virtual distance learning, personalized interaction and assessment learned by students have largely been relegated to online exams and quizzes. Based on detailed and anonymous student feedback and survey data, students evaluated the oral test experience and students reported taking oral trials can personalize the distance learning experience.

Fahmidani et al. [11] determined the attitude of students toward chemistry based on the perception of the learning experience. A questionnaire containing several statements on scientific attitude of students towards chemistry was administered to 55 students from two high schools in Yogyakarta and Indonesia. The questionnaire data were quantitatively analyzed by percentage and were divided into three categories: low, middle, and high. The data indicated that most students still hold scientific attitudes in the middle and low categories. This study provides teachers and other researchers with additional information to improve the attitudes of students toward science because scientific attitudes are also related to the performance of students. Dickson et al. [12] suggested tracking the bilingual skills of students participating in Gaelic medium education and analyzing the effects of learning experience on overall reading skills by providing data of Gaelic/English native speakers in the Gaelic and English versions of the test, and a set of data of English native speakers in the English version of the reading test to compare the reading ability of children in Gaelic secondary school and English secondary school living in the same urban area. The study reported two studies, the first one presented Gaelic reading data from 77 bilingual Gaelic/English children recruited from four different primary school levels, and the other one investigated the performance of a version of the test application to English. It compared the performance of two groups of children (Gaelic and English) on several language skills, including sentence comprehension and reading. About 40 EME children living in the same urban area had taken the test in English. The results showed that the reading ability of children in EME and GME schools was comparable, which demonstrated that schools that took minority languages as a mediate had no adverse effects on reading. Schmidt et al. [13] proposed a learning experience design of health intervention for parents of children with epilepsy. The learning environment combined the theoretical principles of learning science with the user-centered design method and advanced learning technology to provide an efficient and attractive learning experience, especially for adult learners. The preparation phase included the user roles development team and focus implementation team to identify user requirements and product cases. Rapid prototyping was used in designing the iterative learning experience, where the product design was improved between versions, resulting in a final design proof. During the iterative development phase, a usability and user experience method was applied to evaluate the system. The results of three phases of iterative design and development were shown through user roles,

usability data, and qualitative analysis. The results indicated that the learning environment is of high adaptability and is related to the unique needs of adult caregivers of children with epilepsy. The findings also found that user experience is largely positive. The study revealed key insights on how the formative learning experience design process can lead to high relativity and usable interventions for adult learners.

3 Methodology

3.1 Experimental subjects

To analyze the influence of immersive virtual environment on learning effect and learning experience, a class in a university was selected as the experimental class. The students in the experimental class will be taught in an immersive virtual environment, and then two classes were randomly selected as the control class. Reference method [7] and reference method [8] were used to teach students. The average learning levels of students in the experimental class, control A class, and control B class were close. All students involved in the study have learning experiences in an immersive virtual environment.

3.2 Experimental parameters

The experimental parameters are shown in Table 1.

Table 1. Experimental parameters

Item	Parameters/Execution Range	Content
Discount factor	0.9	Used to discount future rewards
Learning rate	0.1	Optimize tuning parameters in the algorithm
Forgetting factor	0.01	Eliminate data saturation
Number of updates	>10	Reach infinitely closer between the upper and lower bounds
Data source	Get actual parameter	Average number of iterations

As for studies on the effects of immersive virtual environment on learning effect and learning experience based on MATLAB experimental platform, the maximum number of episodes in the experiment is set as 200. Under different episodes, the total return value of the immersive virtual environment is calculated to obtain the average return value of the research method.

3.3 Research situation

To promote the professional development of foreign language teachers, it is necessary to create a good immersive virtual environment, improve teachers' recognition of learning performance [14–16], and improve the learning experience of students, so that

teachers can actively teach and students can learn more actively [17–19]. The structure of the research context is shown in Figure 1.

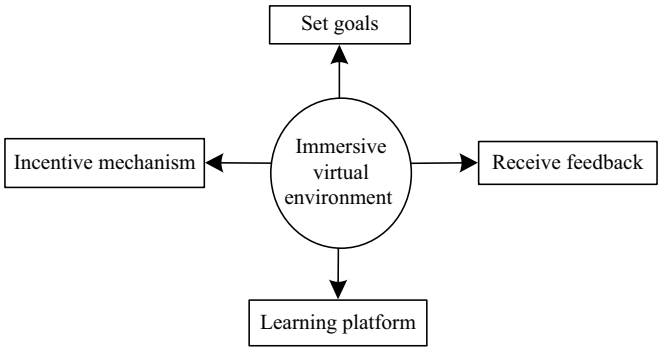

Fig. 1. Structure of the research context

Figure 1 shows the structure of the research context, which means in the process of teaching, the school should be built into a learning institution, a good teaching environment should be created and a learning group should be established so that students can communicate with each other and make full use of their creativity [20, 21]. On the premise of subject-based teaching, teaching standards that are more in line with the humanistic spirit can be established to guide students to create a good scientific research atmosphere in the teaching process, promote vocational development of teachers, and complete the analysis of the influence of immersive virtual environment on learning effect and learning experience.

3.4 Experimental process

The learning process in an immersive environment is composed of the evaluation of the teaching effect, analysis of teaching objectives, preparation of the learning environment, analysis of teaching content, selection of learning strategies, termination of teaching difficulties, and analysis of teaching objects. Other learning teachings and teaching modes in an immersive virtual environment are obtained based on the above processes. The flow chart of the learning process in an immersive virtual environment is shown in Figure 2.

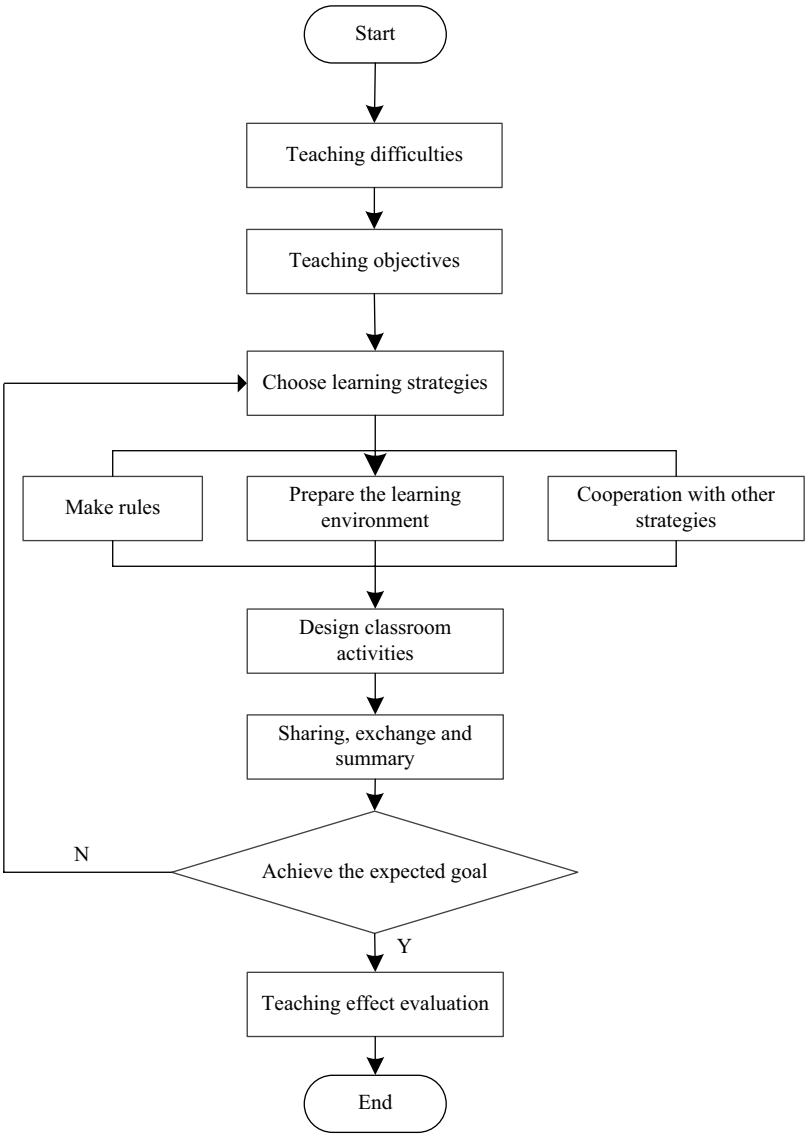

Fig. 2. Experimental process in immersive virtual environment

The teaching mode is a theoretical framework of teaching structure based on learning theory and educational thought, which can meet the needs of students and complete the set purpose, which has integrity and orderliness [22–24]. The teaching strategy is the teaching means and teaching plan adopted to achieve the set teaching tasks and teaching purpose under certain conditions, such as technology, method, organization form, etc. The differences between teaching strategy and teaching mode are as follows: teaching mode is composed of several teaching strategies, teaching strategies are more detailed and specific, while teaching mode restricts the teaching strategy. Therefore, a

reasonable and scientific teaching mode is the premise of exploring learning strategies in an immersive virtual environment [25].

4 Results analysis

To ensure the effectiveness of the experiment, it compared the Reference [7] method and Reference [8] method with the method in this study, observed the experimental results, and compared the average return value of each method. The comparison of the average return values under the three methods is shown in Figure 3.

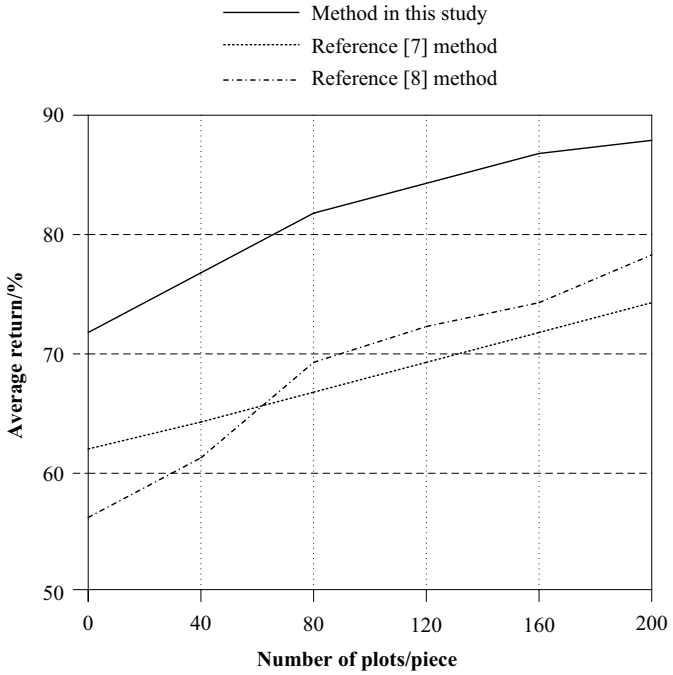

Fig. 3. Comparison of the average return value

Figure 3 shows that the maximum average return value of the Reference [7] method, Reference [8] method and the method in this study is 74%, 78%, and 88%, respectively. Therefore, compared with the reference method, the method in this study has a higher average return value and a faster convergence speed.

It applied the learning method in an immersive virtual environment in the English class. After a month of teaching, the scores of students in the experimental class and the control class were compared, and the comparison results are shown in Table 2.

Table 2. Scores of students in experimental class and control class

Students	Experimental Class (Score)		Control Class A (Score)		Control Class B (Score)	
	Original	Current	Original	Current	Original	Current
1	88	91	88	85	89	82
2	87	96	81	83	83	81
3	92	94	83	82	83	80
4	87	99	86	87	86	81
5	85	97	83	80	85	80
6	80	92	86	85	87	82
7	84	97	84	82	82	81
8	81	93	85	83	81	81
9	78	90	84	85	86	85
10	85	98	87	88	85	81
Average	84.7	94.7	84.7	84	84.7	81.4

Every 10 students were selected randomly from the experimental class and two control classes to compare their original and current scores. According to the data in Table 2, before using the research and reference methods, the average score of students was 84.7. After the experimental class used the method in this study, the average English score of students increased by 10 points after a month of learning, while the scores of students in control class A and control class B did not increase significantly, and some even had a setback, and their scores decreased by 0.7 and 3.3 points, respectively.

To further analyze the influence of the learning process on students in an immersive virtual environment, an investigation was conducted to confirm whether learning in an immersive virtual environment is helpful to their study. The survey findings are shown in Figure 4.

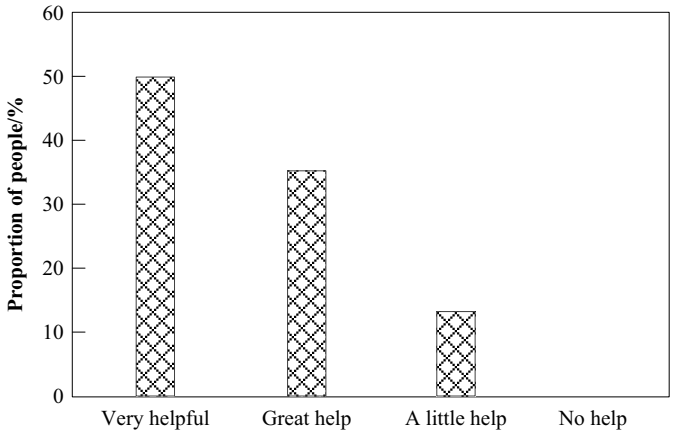

Fig. 4. Survey findings

Figure 4 shows that 50% of students believed that learning methods in an immersive virtual environment are very helpful for their learning, 37% believed that learning methods in an immersive virtual environment are helpful for their learning, 13% believed that learning methods in immersive virtual environment are of little help for their learning, and 0% believed that learning methods are not helpful for their learning. In summary, both the analysis of educational big data and the survey findings can reflect learning in an immersive virtual environment is helpful to the study of students and can improve their academic performance of students.

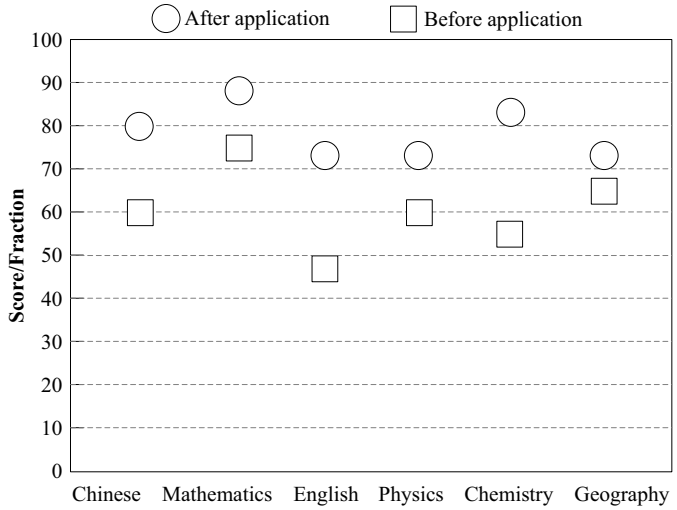

Fig. 5. Scoring results after adopting the method in this study

Figure 5 shows that the comprehensive score of teaching effect obtained by the immersive virtual environment is higher than that before the application in Chinese, mathematics, English, physics, chemistry, and geography. Because learning in an immersive virtual environment has the characteristics of fun, conceptuality, task, exploring, immersive, and autonomy, learning in an immersive virtual environment changes the teaching process into a game, guides students to learn independently, and solves the issue of monotony in traditional teaching methods. Based on the characteristics of the game, it stimulated the learning interests of students, changed their learning behavior and mechanism of students, and improved their learning efficiency of students, which had a good influence on the learning effects and learning experiences of students in each discipline.

5 Managerial implications

5.1 Course features

To better evaluate the teaching effect of immersive virtual environment, it is necessary to understand the course features of the immersive virtual environment. Hence, the

course features of immersive virtual environment are divided into two parts: learning objective, feedback, and interaction.

In the classroom with the application of an immersive virtual environment, the activity of the classroom atmosphere is enhanced, the distance between teachers and students narrowed, and teachers can become true friends of students. It shall treat and guide students from an equal perspective to understand and learn theoretical knowledge and guide them to practice. The course guided by the immersive virtual environment is easier to stimulate students' self-consciousness of reflection and innovation, and can also enhance the sense of unity and collaboration among students, which effectively improved the degree of interaction and feedback in the classroom, and improve learning effects and learning experiences.

5.2 Design of teaching activity

The theory of immersive virtual environment is applied to specific classroom teaching and set the classroom teaching activities. The design of classroom teaching activities includes question-raising between students and teachers, the learning process in an immersive virtual environment, problem-solving, immersive practice, and summary evaluation. Under the guidance of the teachers, they shall first set learning goals, which are to put forward problems; the learning task is to learn in an immersive virtual environment to solve this problem. Teachers guide students to learn in an immersive virtual environment through the application of various equipment and teaching methods. Finally, students' performance and learning results in the classroom by the teacher suited and concluded to determine the problems and make improvements.

5.3 Analyze application problems

It also needs to pay attention to some problems when applying the theory of immersive virtual environment into practice. For example, the core of learning in the immersive virtual environment is still learning, and the purpose of immersion is to promote learning, the learning in the immersive virtual environment is to substitute the immersive spirit into the learning process and promote the improvement and development of learning methods. Although the immersive virtual environment is extremely interesting, it should be kept in mind that the purpose of learning in the immersive virtual environment is to stimulate learning interests, rather than to indulge in immersion and ignore learning. The selection of specific immersive methods should also be evaluated according to the learning tasks and objectives, to achieve a balance and coordination between them.

Attention should also be given to the positioning of teachers in the application of immersive virtual environment theory. Students have strong independence during the process of learning in an immersive virtual environment, but teachers should also actively undertake their responsibility to lead and guide students. Teachers should not only be game designers, organizers, and bystanders but also pay close attention to the entire learning process in an immersive virtual environment. Adjustments should be made promptly when monitoring students' learning status and acceptance of different

situations, and teachers also take care not to interfere excessively, thereby depriving students of the ability to think independently and innovate.

6 Conclusion

With the continuous acceleration of information technology, people's requirements for education are becoming increasing, and the teaching methods of teachers should be changed according to different learning methods of students to adapt to the requirements and changes of the times. The immersive virtual environment has promoted the development of various teaching methods and has become a hot topic in contemporary research combined with various learning resources. The immersive virtual environment provided a new idea for education and changed the traditional teaching mode. It can increase the participation and fun of the classroom when adopting immersive experiences in the teaching process. This study analyzed the learning effects and learning experiences verified the positive effects of the immersive virtual environment on the learning of students and paved a foundation for the development of learning methods.

The following conclusions are drawn. Compared with the literature method, the influence of immersive virtual environment on learning effects and learning experiences has a higher average return value and a faster convergence speed. Before using research methods and reference methods, the average score of students was 84.7 and the average score of students in the experimental class after adopting the method in this study and one month of learning increased by 10 points. Meanwhile, 50% of students think learning methods in an immersive virtual environment would be very helpful to them. After adopting the learning method in an immersive virtual environment, the comprehensive score of teaching effect in each discipline obtained by students is higher than that before the application, indicating the positive influence of the learning effects and learning experiences of students.

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