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VR in Basic Education 2010-2020: A Disciplinary Difference Perspective

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Abstract

Virtual reality, also known as VR technology, is currently the new darling in the field of education and teaching. In recent years, especially in basic education, the application of virtual reality technology has become increasingly widespread. This paper briefly introduces the application of virtual reality technology in various aspects of basic education and analyzes its main problems: the physical discomfort brought by VR devices to users; the insufficient quantity and low quality of teaching resources developed using VR technology; and the lack of effective guidance from teachers for VR experiences. On this basis, this paper proposes relevant countermeasures in order to improve the overall teaching quality of basic education.

Keywords

VR; virtual reality; basic education.

1. Introduction

Virtual Reality, or VR for short, is a technology that uses computers to simulate the virtual reality world, thus creating a virtual world. It is a technological method that enables users to enter a purely virtual space, and it is a way for computers to process and manipulate or visualize various complex information and interact with it[1] . Virtual reality technology is widely used in all areas of social life. The Ministry of Education promulgated the Opinions on Strengthening and Improving Experimental Teaching in Primary and Secondary Schools in November 2019, pointing out that the combination of traditional experiments and modern technologies should be emphasized in the teaching process in the future, so as to enhance the interest and attractiveness of experiments and improve the quality and effectiveness of experiments. Virtual reality is one of the modern emerging technologies, and its application to basic education can enhance students' independent learning ability and reduce their cognitive burden by combining real objects with virtual objects[2] . In addition, basic education using virtual reality technology has the advantages of breaking time and space limitations, making up for the lack of teaching practice conditions, and reducing the risk factor of experiments[3] . However, there are still many problems in the practical application of virtual reality technology in the actual basic education, such as: the physical discomfort brought by VR equipment to users, the lack of teaching resources developed by using VR technology, and the low quality. This paper proposes solutions to these problems, hoping to give educational researchers a reference to improve teaching effectiveness.

2. The current situation of VR application in basic education

In this paper, we firstly used the academic journals of China Knowledge Network (CNKI) database, which has the widest coverage, as the data source, and conducted a literature search with the theme=Virtual Reality AND Basic Education, with the initial time set to January 1, 2010

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and the deadline set to December 31, 2020, and obtained a total of 42 articles. After excluding conferences, newspapers, etc., a total of 39 pieces of valid literature were obtained. Based on the valid literature obtained, it can be seen that the subject distribution of VR applications in basic education is mainly concentrated in three areas: some arts subjects (history, geography, etc.), some science subjects (physics, chemistry, etc.) and non-formal subjects (safety education, etc.). Based on this background, this paper will analyze the application of virtual reality in basic education from different disciplines.

2.1. Application in liberal arts disciplines such as history and geography

The traditional teaching methods of history subjects are single and difficult to combine with modernization, which is not conducive to improving the comprehensive quality of teachers and students. Teachers also hardly use information-based teaching methods for teaching, and students have little opportunity to contact new technologies, understand new knowledge and feel new changes. Therefore, there is a significant difference between students trained by traditional teaching methods and those trained by new teaching methods, such as multimedia, in terms of knowledge, innovation and practical ability, which does not meet the requirements of modern society for talent training.

The use of VR technology to teach history can reproduce the major events and battles in history, bring students closer to history, and strengthen their understanding and memory of history. In the study of history, it is important to learn not only the historical time, events and systems, but also the patriotic sentiments contained in history, thus helping students to form correct values. Among the five core qualities of history advocated by the new curriculum reform, the feeling of family and country refers to the humanistic pursuit that should be possessed in learning and exploring history, which reflects a high sense of identification, belonging, responsibility and mission for the country[4] . In the virtual historical environment established, students can feel more realistically the loss of power and disgrace in the late Qing Dynasty, the break with the old and the new in modern times, and the patriotic spirit of national heroes through role experience and other ways, which enriches students' emotional experience.

Many secondary school geography knowledge and principles are abstract and difficult to express in words. Due to the limitation of objective conditions, it is difficult to prepare teaching aids for some teaching contents. The traditional geography classroom teaching mode is single and cannot inspire students' image thinking in many forms and angles, which to some extent restricts students' creative thinking. Students are limited to listening to the lectures in the classroom, with a monotonous learning environment and a single teaching mode, thus depriving them of the desire to investigate knowledge.

The creation of virtual reality scenes can be achieved through 3D modeling software in geography teaching. In geography classes, students can visualize geographic scenes by wearing devices such as helmets, handles, data suits, and data gloves. For example, when learning "common weather systems", teachers can use virtual reality technology to build virtual real-world scenes so that students can immerse themselves in the atmospheric motion space in the classroom and get a realistic visual and auditory experience so that they can have a full understanding of the weather formed by cold and warm air masses, cold and warm fronts, and cold and warm fronts. By showing the laws of atmospheric motion in a dynamic way, students can have a more intuitive understanding of complex and variable weather and develop their thinking about perceived motion, thus improving the vividness in geography teaching; through contextualized virtual experiments, situational interaction in the geography classroom can be enhanced, allowing students to explore the troposphere in greater depth and gain a deeper understanding of the causes of complex weather formation[5] .

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2.2. Application in science disciplines such as physics and chemistry

Physics is an experiment-based course. Through experiments, students are able to understand basic concepts, physical principles and causes of phenomena. Experimental teaching enables students to have a rational perception of abstract concepts, relate physical principles to real phenomena, and apply knowledge from books to real life[6] . There are some experiments that are dangerous or difficult to complete under the present conditions, so the application of virtual reality technology in physics subjects is mainly in virtual experiments. For example, learning about gravity, the concept of the object is too large, so it is impossible to make students observe physical phenomena through experiments in real situations. In virtual labs, students can simulate real phenomena through simulated experiments, and are not limited by time and space, and can easily perform experiments at any moment on their computers or mobile devices. In addition, the virtual environment allows for the realization of macroscopic and microscopic phenomena, making visible objects that are difficult to observe with the naked eye. For example, when teaching "molecular thermal motion", students can treat pollen diffusion as pollen motion. By simulating water molecules and pollen in a virtual environment, students can quickly understand that the irregular motion of pollen is caused by the irregular motion of water molecules.

In the content of secondary school chemistry experiments, due to the toxicity and flammability and explosiveness of the experimental drugs themselves, many experiments will have a greater impact on the safety of students and teachers in the experiments and cause environmental pollution. Applying virtual technology to experimental teaching, highly simulated experiments made with 3D technology effectively prevent the escape of toxic gases and accidents such as fires and explosions, allowing students to conduct experimental investigations in a green environment without having to worry about experimental reagents, experimental equipment and their own safety.

In addition, there are many experiments involving the motion of microscopic particles, which are difficult to demonstrate in the traditional experimental way, and students are easily confused. With the help of virtual reality technology, we can simulate macroscopic phenomena in a microscopic way, show the spatial structure of matter, and simulate the motion of particles with animation, which can effectively break through the difficult teaching points. For example, in the chapter of "ionization of acid and alkali salts in aqueous solution" in high school chemistry, students are familiar with the common salt in life, but it is difficult for them to observe and understand the crystal structure and its dissolution process in water with their naked eyes. With the help of virtual reality technology, we simulated the spatial structure of salt from macroscopic crystals to particles composed of sodium and chloride ions, and at the same time used animation to simulate the process of dissolving and dissociating salt crystals in water under the action of water molecules, with sodium and chloride ions breaking away from the crystal surface and entering the water, forming hydrated sodium and hydrated chloride ions that can move freely with water molecules. It can be seen that the application of virtual reality technology in chemical microscopic particle motion experiments can well demonstrate microscopic phenomena as macroscopic, which effectively promotes students' understanding of certain abstract contents and breaks through the barriers to students' learning[7] .

2.3. Application in safety education

Children's safety education has always been a general concern of the whole society. In 2018, the Ministry of Education issued the Ten Guidelines on Professional Conduct for Teachers in Primary and Secondary Schools in the New Era, which proposed to raise children's safety awareness and strengthen safety education for students, which shows that there are quite serious problems with the current safety education for primary and secondary school students[8] . Currently, safety education is mainly conducted in the form of both theoretical

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lectures and video observation, both using hypothetical brain scenarios constructed and trained according to pre-defined escape routes and methods. These approaches are theory-based and lack practice, resulting in a weak sense of crisis among students in actual operation, leading to "distortion" of the effect of safety education.

Compared with traditional methods, the use of VR has significant advantages. the addition of VR technology has brought new life to the safety education industry, and VR-based safety education has lower investment costs than traditional education, but better results. Virtual reality safety education is rapidly developing as a new form of safety education.

First, VR technology can fully simulate and emulate realistic fire scenarios, creating a fire scene environment that is both realistic and safe[9] , which helps students recognize some possible misconceptions in their fire escape and thus avoid possible hidden dangers in actual drills. XU established a VR-based fire training simulator with smoke assessment capability, taking Lanzhou Institute of Petrochemical Technology as an example, and designed Development of Unity 3D-based campus fire emergency drill system, etc.[10] .

Second, the VR environment can be practiced by adjusting scenarios of dangerous emergencies and natural disasters as a way to exercise students' resilience in emergency situations, as a way to exercise students' resilience in emergency situations and provide students with a targeted virtual real-world training. Example: repeated practice in virtual scenarios such as traffic intersections[11] , thus enhancing safety awareness and improving safety skills. Finally, VR technology can provide features such as realistic images and audio explanations to enhance the fun and immersion of learning, allowing students to use VR technology to build learning environments for active exploration.

In recent years, earthquake disasters have occurred frequently and caused huge loss of life and property in earthquake areas of China. To enhance the awareness of society about earthquake disaster prevention, the country is vigorously carrying out earthquake safety education. Liu YF et al. developed an interactive remote earthquake prevention education software using 3ds max, Virtools and other software, which breaks the limitation of time and space and simulates different scenarios during earthquakes so that the experiencer can be trained to escape skills in different scenarios[12] .

3. Shortcomings and countermeasures of VR application in basic education

The introduction of virtual reality technology in basic education has obvious superiority. However, considering that the VR equipment itself has defects, students at the basic education level have different levels of interest in and mastery of the technology, and teachers have a relatively low level of using virtual reality technology, many problems have arisen in the process of application.

3.1. Physical discomfort to learners from VR devices

Before the application of virtual reality technology for teaching, most people equipment use training and environmental adaptation training, easy to experience in the process of physical discomfort. Each learner will have different feelings about the use of the equipment, and the quality of the equipment and the comfort level brought by the design is also an important influencing factor. When people use virtual reality devices to navigate interactive scenes, the virtual scene in their minds remains for quite some time, and many virtual reality systems use tracking devices to record people's head movements and adjust the images accordingly.

As a result, some learners may experience physical discomfort when using virtual reality devices. This discomfort may lead to dizziness and nausea, and there are safety hazards such as falls. The delayed effect of time is the main cause of discomfort, and another reason is that either

the headset or the lens may affect balance leading to fatigue, especially in fully immersive systems where the effect on people is more pronounced. Therefore, virtual reality devices also need to be promoted with safety guidelines and usage methods in order to minimize the discomfort caused by using the devices.

3.2. Insufficient quantity and low quality of teaching resources developed based on VR

Virtual reality technology, as an emerging technology, has been widely used in various industries and is driving the overall development of related industries. However, at this stage, there is still a lack of uniformity in the standard of VR resource content, and a lack of innovation in related content and technology, resulting in the low quality of these resources. In addition, there is a huge gap in the development of teaching resources in education teaching, which is far from meeting the needs of education teaching, not to mention the ability to find suitable virtual reality technology resources directly applied to the basic education stage, which is one of the reasons why VR technology cannot be widely used in the basic education stage soon. Therefore, there is a need for continuous improvement and innovation of VR technology and strengthening the integration of VR technology and education to meet the development needs of education [13].

3.3. Lack of effective guidance from teachers in VR experience

Virtual reality technology applied to basic education also has higher requirements for teachers' teaching ability. Teachers must redesign and plan virtual reality according to the needs of teaching objectives, and also adjust the conversion of virtual and real environments in a timely manner, and most importantly, give students effective guidance during the teaching process. Usually, the teachers' failure to provide timely and effective guidance causes students to explore aimlessly in the VR learning process; they fail to guide students to summarize and reflect after the VR experience, which affects the self-construction and transfer of knowledge. Therefore, the VR learning process needs to provide the necessary learning guidance and evaluation to improve the learning effect. Guidance and evaluation can be integrated and varied, and carried out flexibly in both the virtual and real environments. Timely summarize, summarize and guide students' learning gains after the experience, so that the experience is truly efficient, interesting, beneficial and useful.

In addition, teachers should also improve their own ability to use and develop virtual reality technology resources. Relevant departments can provide a series of trainings or lectures for teachers after class time, so as to improve teachers' ability in developing and using virtual reality technology resources in basic teaching.

In conclusion, while we improve VR devices, it is more important to focus on the pedagogical goals that different disciplines focus on and to teach strictly according to the pedagogical goals. Educators as well as learners have to go through a process of adaptation and training before using VR devices, and proficiency in the use of the devices may be a prerequisite for good teaching. Educators should give full play to the advantages of VR technology to optimize the curriculum, according to the different characteristics of each subject, so that it can be used to maximize the value of teaching in different subjects, so that students at the basic education level can be sublimated in knowledge, skills, and emotional learning.

4. Summary and Outlook

VR technology has become a technology that cannot be ignored in the application of basic education, and its deep integration with education teaching will promote the in-depth development of teaching reform, which has an important role in improving education, improving the teaching environment, enriching teaching resources, optimizing the teaching

process, and cultivating personalized and innovative talents. However, because the current technology is not mature enough, there are indeed some problems in the integration process. In the future, with the gradual improvement of the application level of VR technology in basic education, these problems will eventually be solved, VR technology will not only be widely used in the above subjects, but will also penetrate into various subjects, and the vividness and excitement of basic education will have a new change[13] , and the development of basic education teaching in China will achieve a qualitative leap.

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