# Virtual Reality in Education: Breaking through Tradition and Leading the New Trend of Future Learning

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**Abstract.** This study aims to explore the application of virtual reality technology in the field of education. It deeply discusses the advantages of its application in education and the changes it brings to the education model. The results show that virtual reality technology has a significant positive impact on the field of education. Virtual reality creates an immersive learning environment, which greatly stimulates students' interest and motivation in learning; provides students with safe and low-cost practical opportunities, and improves their practical operation ability and depth of knowledge understanding; it can realize personalized learning and differentiated teaching according to individual differences of students; it also breaks the time and space limitations and expands educational resources and horizons. Although virtual reality technology has a significant positive impact in the field of education, it also faces challenges such as technical costs, teaching content design, and students' physical and mental health. In the future, on the basis of solving these problems, its the advantages of these technologies need to be further exerted to promote the innovative development of education.

**Keywords:** Virtual Reality, Education, Teaching Strategies.

## 1 Introduction

In recent years, with the rapid development of science and technology, virtual reality (referred to as VR) technology has gradually emerged and shown great potential in the field of education, bringing revolutionary changes to the education field and providing learners with a new and immersive learning experience. VR technology provides students with an immersive learning experience by simulating real scenes, greatly enriching teaching content and methods. It can not only break through the drawbacks of traditional teaching, and improve students' learning initiative and participation, but also provide a highly personalized learning experience, improve education quality and efficiency, promote education equity, and innovate teaching models. At the same time, it allows students to experience real scenes in a safe environment and promotes students' cross-cultural learning and the cultivation of global awareness.


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In 2021, six departments including the Ministry of Education issued the "Guiding Opinions on Promoting the Construction of New Educational Infrastructure and Building a High-quality Education Support System", proposing to promote the integrated development of online and offline education with new infrastructure and promote the digital transformation of education. The opinion also proposes to deploy subject-specific classrooms and create a new vivid and intuitive classroom relying on equipment such as perceptual interaction and simulation experiments [1]. The Institute of Education of Tsinghua University defines the digital transformation of education as a new educational form following the in-depth integration of information technology and education and teaching. The communication technology used in the advanced stage of the information society will be VR technology, the communication mode will be immersed communication integrating the virtual and the real, and the talent demand will be for future-oriented innovation ability.

These all indicate the need to use VR technology to achieve educational digitalization and modernization and cultivate urgently needed talents with autonomy and innovation in the modern era.

This research aims to deeply explore the application value of VR in education, analyze its positive impacts on students' learning effects, personalized learning, safe practice, and other aspects. At the same time, by analyzing the application status of VR technology in the field of education, predicting its future development direction, it provides references for educators and policy makers to better promote the application and development of VR technology in education.

## 2 Virtual Reality and Education

VR technology is a comprehensive technology that comprehensively uses multiple technologies such as computer graphics, sensing technology, display technology, interaction technology. The technical support for the application of VR in education mainly includes the integration of multiple technologies such as high-performance computing, three-dimensional modeling, human-computer interaction technology, and sensing technology. VR has been increasingly explored as a pedagogical tool in education, with a focus on enhancing learning outcomes and student engagement [2]. McGovern et. al. [3] specifically examined the use of VR in business classes to improve students' communication skills through effective presentations and public speaking events. The VR application allowed students to evaluate their presentation skills, practice, and gain confidence in delivering effective presentations. Similarly, Soliman et. al. [4] argued that VR is an excellent tool in engineering education, citing advancements in VR technology that have made it more accessible for educational purposes.

VR technology needs to properly combine real environment information and computer-generated objects to make a desirable experience. Participants cannot do without relevant tools. There are head-mounted displays (HMDs) and other ways for VR visual perception. HMDs have low-cost products such as Google Cardboard and high-priced products such as Oculus Rift, HTC Vive, and PlayStation VR. When used in the edu-

cation field, not only product performance but also price should be considered. Hamilton et. al. [2] conducted a systematic literature review that compared quantitative learning outcomes using Head-Mounted Display (HMD) based immersion VR with traditional pedagogical methods such as desktop computers and slide shows. The study found that research in this area has been limited, highlighting the need for more experimental studies to further explore the effectiveness of VR in education. Different from HMDs, CAVE does not require a head-mounted display, and users can interact with virtual objects on the projection screen through devices such as joysticks or gloves. Another relatively accessible device is desktop VR. Users can interact with virtual objects in the display through devices such as a mouse [5]. In addition, there are VR cabins, mainly used for education and training, such as aircraft cockpit simulations [6], and wearable devices such as Teslasuit.

In order to comprehensively explore the recent academic research on VR technology in the context of education, the research data for this article was obtained from the CNKI database, which is the largest database of academic papers and scholarly electronic resources in China. The keywords searched were 'virtual reality' and 'education', and the time span of the study was from January 2014 to October 2024, which is nearly eight years. This time period was chosen to capture groundbreaking work and recent research advances in the integration of VR technology in education. The types of literature searched included journal articles, conference papers, and scholarly publications, increasing the reliability and credibility of the data collected. The distribution of the number of relevant literature on VR and education during the last decade and the distribution of keywords is shown in Figure 1 and Figure 2.

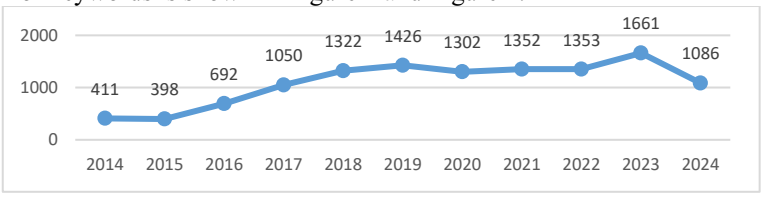


**Fig. 1.** Distribution of documents by year.

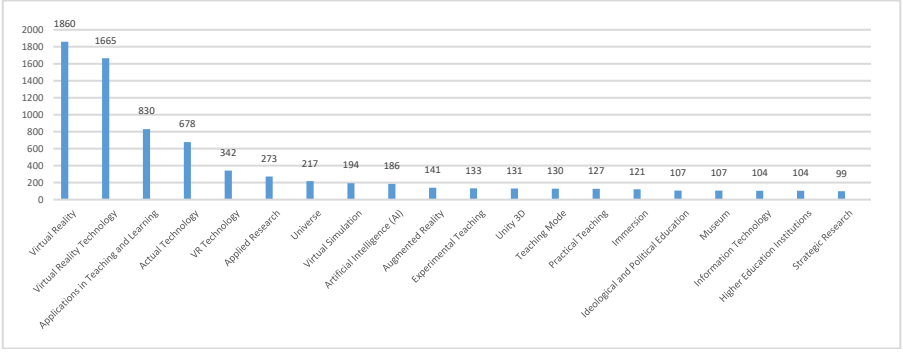


**Fig. 2.** Distribution of documents by keywords.

# 3 Advantages of Virtual Reality in Education

## 3.1 Enhancing Learning Initiative

Breaking traditional bonds. Traditional teaching methods often rely mainly on books, blackboards, and teacher lectures, with students in a passive state of receiving knowledge. VR technology breaks this traditional bond and brings students into a vivid and lifelike virtual world. The immersion experience provided by VR makes learning more interesting and vivid, greatly stimulating students' learning interest. At the same time, compared with traditional teaching, VR technology has obvious attraction. It can transform abstract knowledge into intuitive visual and auditory experiences, making it easier for students to understand and remember.

Improving learning effectiveness. VR technology improves learning effectiveness by stimulating students' learning interest and motivation. When students have a strong interest in the learning content, they will more actively participate in the learning process, actively think about problems, explore the mysteries of knowledge.

In the virtual environment, students learn according to their own learning rhythm. If they encounter difficult-to-understand knowledge points, they can watch and experience repeatedly until they are fully mastered.

In addition, VR technology can also improve learning effectiveness through interactive learning experiences. Students interact with the learning content in the virtual environment, and this interactive learning experience allows students to more deeply participate in the learning process and improve learning effectiveness.

## 3.2 Personalized Learning Experience

Tailoring Learning Paths. VR technology can tailor learning paths according to students' learning needs, learning styles, and learning progress. By collecting students' learning data, such as learning time, answering questions, and interaction records, the VR system can analyze students' learning characteristics and needs and generate personalized learning paths for them.

Improving Learning Targetedness. Teachers can understand students' learning situation in real time through the VR system, adjust teaching content and methods according to students' feedback, and improve the togertherness of teaching. VR technology also provides teachers with more teaching resources and tools to help teachers better meet students' personalized needs. For example, teachers use VR technology to create virtual laboratories to allow students to conduct experimental operations in a safe environment; teachers use VR technology for distance teaching to provide personalized teaching services for students in different regions.

## 3.3 Safe Practical Environment

Simulating Dangerous Scenarios. In disciplines such as chemical experiments and physical experiments, there are some dangerous experimental scenarios, such as explosions and toxic gas leaks. VR technology can simulate these dangerous scenarios and

allow students to conduct experimental operations in a safe environment. In addition, VR technology can also simulate some experimental scenarios that are difficult to achieve in reality, such as space exploration and deep-sea exploration. Through these virtual experiments, students can broaden their horizons.

Reducing Costs and Risks. In actual experimental teaching, it is necessary to purchase a large amount of experimental equipment and materials, which is costly. Moreover, some experimental operations have certain risks, such as explosions and toxic gas leaks in chemical experiments, which may pose a threat to students' safety. VR technology can effectively reduce these costs and risks. Through the virtual laboratory, students can conduct various experimental operations without the need to purchase actual experimental equipment and materials. This not only reduces the experimental cost but also reduces the loss of experimental equipment and materials. At the same time, the virtual laboratory can ensure that students conduct experimental operations in a safe environment and avoid the risks that may occur in actual experiments.

# 4 Virtual Reality Changing the Education Model

## 4.1 Stimulating Learning Interest and Motivation

The traditional education method is relatively monotonous, and students are prone to be passive. VR changes this situation by creating an immersion environment. It can make students feel as if they are in various scenarios, such as traveling back to ancient times in history class and observing the microscopic world in science class. This kind of experience greatly stimulates students' curiosity and desire to explore, making them change from passive learning to active learning and enhancing their learning interest.

## 4.2 Promoting Knowledge Understanding and Mastery

Presenting abstract concepts intuitively. Many subject knowledge is abstract, and it is difficult for students to understand. VR can transform it into an intuitive experience. In physics, it can display the phenomena of electric and magnetic fields; in mathematics, it can present geometric figures in three dimensions. This makes it easier for students to understand the principles and deepen their mastery of knowledge.

Providing practical operation opportunities. Practice is very important for knowledge consolidation. VR provides a safe and low-cost practical platform. Dangerous chemical reactions can be simulated in the virtual laboratory, and students can operate and observe. It can also simulate difficult-to-realize scenarios, such as space and deep-sea exploration, broadening students' horizons, improving their problem-solving abilities, and promoting the combination of theory and practice.

## 4.3 Realizing Personalized Learning

Tailoring learning paths. Students have great individual differences. VR analyzes students' characteristics based on learning data such as time, answering questions, and

interaction, and customizes personalized paths for them. Fast learners have challenging content, and struggling students have basic explanations and targeted exercises to adapt to their respective rhythms and improve learning effects.

Adjusting teaching strategies in real time. Teachers can use this technology to understand students' situations in real time. Adjust teaching content and methods according to feedback, such as timely explaining when finding students' knowledge confusion. It also provides rich resources and tools to meet the needs of different students and achieve individualized teaching.

### 4.4 Creating a Safe Learning Environment

Simulating dangerous scenarios. Some subjects have dangerous experiments, such as chemical explosions and high-voltage electricity in physics. VR can simulate these scenarios, allowing students to safely experience response measures and operation procedures, and also simulate extreme environments. It ensures students' safety and enhances their ability to respond and apply knowledge.

Reducing costs and risks. Actual experimental teaching has a high cost, a large investment in equipment, and safety risks. The virtual laboratory reduces costs, and students can experiment without actual equipment and materials, avoiding accidents and reducing the pressure of safety management.

## 5 Conclusion

The application of VR technology in the field of education shows great potential and transformation power. This article mainly analyzes the unprecedented changes brought by VR technology to education from the advantages of VR for education and the educational changes it brings.

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