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ORIGINAL

Analysis of the Teaching Effectiveness of Virtual Reality Technology in Higher Education

Análisis de la efectividad docente de la tecnología de realidad Virtual en la educación superior

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ABSTRACT

Virtual reality offers a more immediate and engaging educational experience for university students. By recreating real-world or even fantastical settings, learners can engage in training in a secure and hazard-free atmosphere, which is crucial for boosting their enthusiasm and practical skills. The introduction of VR into teaching has revolutionized the conventional educational approach, particularly through its interactive and immersive features, which have been a game-changer. VR surpasses traditional teaching by catering to personalized learning needs and encouraging proactive student inquiry and study. Empirical studies on teaching outcomes indicate that VR is highly effective in fields such as medical, engineering, management education, and physical education. In the medical field, VR can offer a highly realistic anatomical study environment, aiding students in acquiring intricate medical knowledge and techniques more effectively.

Keywords: Virtual Reality Technology; VR; Teaching Effectiveness; Higher Education; Tertiary Education; Technical Learning.

RESUMEN

La realidad Virtual ofrece una experiencia educativa más inmediata y atractiva para los estudiantes universitarios. Mediante la recreación de escenarios del mundo real o incluso fantásticos, los estudiantes pueden participar en la formación en un ambiente seguro y libre de riesgos, que es crucial para aumentar su entusiasmo y habilidades prácticas. La introducción de la RV en la enseñanza ha revolucionado el enfoque educativo convencional, particularmente a través de sus características interactivas e inmersivas, que han sido un cambio de juego. VR supera la enseñanza tradicional por atender a las necesidades de aprendizaje personalizado y fomentar la investigación y el estudio proactivo de los estudiantes. Los estudios empíricos sobre resultados de enseñanza indican que VR es altamente eficaz en campos tales como medicina, ingeniería, educación de la gerencia, y educación física. En el campo médico, VR puede ofrecer un ambiente altamente realista del estudio anatómico, ayudando a estudiantes en adquirir conocimiento y técnicas médicas intrincadas más eficazmente.

Palabras clave: Tecnología de Realidad Virtual; VR; Eficacia de la Enseñanza; Educación Superior; Educación Superior; Aprendizaje Técnico.

INTRODUCTION

As science and technology progress swiftly, the realm of education is experiencing changes that are truly without precedent. Virtual Reality (VR), as an emerging form of informational technology, has been implemented across a broad spectrum of sectors, with higher education being no exception. By crafting an encompassing virtual setting, VR technology introduces a novel learning method to students, which can significantly enhance their eagerness to learn and substantially elevate the efficacy of teaching. Within the sphere of higher education, the conventional teaching methods have struggled to align with the evolving educational demands of students. Students are more intuitive, interactive and experiential in their acquisition of knowledge, and VR technology can meet these needs. Through VR technology, teachers can build a three-dimensional virtual classroom, so that students can participate in the classroom personally, so as to achieve better teaching results. [1] Nevertheless, while the educational sector holds vast promise for VR technology, there exists a scarcity of studies scrutinizing its pedagogical impact within higher education. Thus, the aim of this investigation is to delve into the instructional efficacy of virtual reality technology in tertiary education, and to evaluate the benefits and constraints of VR technology in contrast to conventional teaching methods.

By examining pertinent literature from both domestic and international sources, this paper will scrutinize the deployment of VR technology across various disciplines such as medical, engineering, and managerial studies, along with its precise role in amplifying educational outcomes. Investigating the instructional efficacy of virtual reality technology in higher education not only aids in propelling the advancement of educational digitalization, but also supplies an abundance of educational materials and methodologies for academicians. Simultaneously, this research will lay down a theoretical groundwork and practical guidance for the evolution and progression of post-secondary education, thereby facilitating the continuous improvement of the quality of higher education.

METHOD

Since the birth of virtual reality technology in the 1950s, it has gone through a long process from concept to wide application. Early virtual reality systems relied heavily on simple computer graphics and sound effects, but as technology continues to advance, the capabilities and experience continue to be upgraded. Virtual reality technology is mainly based on computer simulation, which integrates artificial intelligence, big data, sensing and system simulation technologies to form advanced virtual reality technology and is applied to various fields. In essence, virtual reality technology is the use of people's "visual, auditory, touch" and other sensory organs, through virtual pictures and sound sensing, to create a highly simulated virtual picture for people, so that people can be personally on the scene; at the same time, it can also use language and gestures to form a human-computer interaction mode, bringing people a better simulation experience.[2] As illustrated in figure 1, the data indicate that China's VR market size has grown from 6.8 billion yuan to 79.2 billion yuan between 2016 and 2022. It is anticipated that by 2023, the VR industry in China will expand to 105.2 billion yuan. VR technology has the potential to be utilized across a multitude of sectors and can generate substantial economic advantages. The challenge for professionals in the field is to effectively harness VR technology and to explore its integration into their respective domains of advancement.

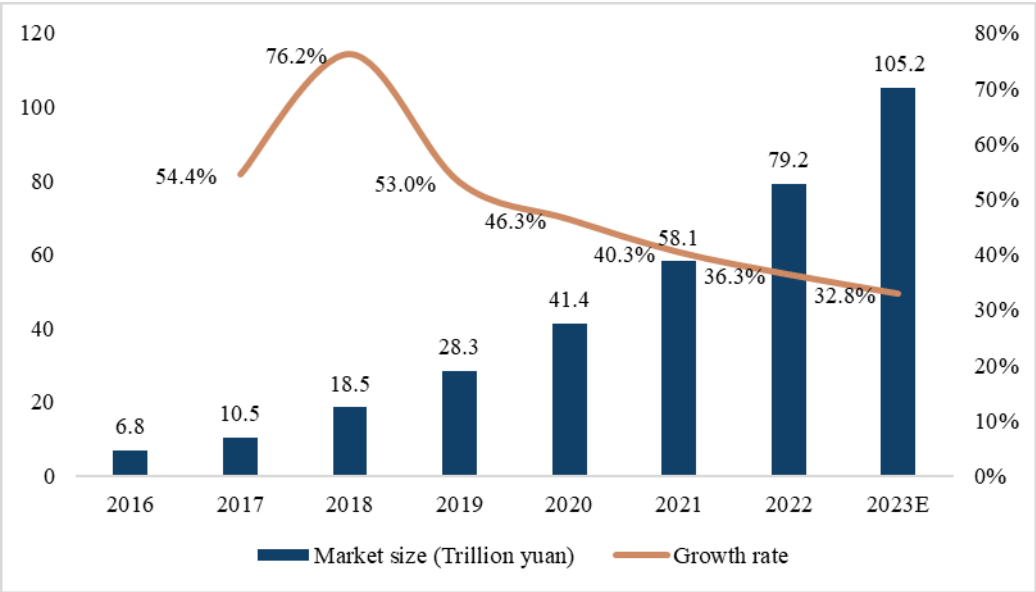

Figure 1. Statistics on the Market Size of China's VR Industry

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Characteristics

Virtual reality technology has the characteristics of immersion, interaction and imagination, which focuses on the psychological and physiological characteristics of human beings, setting the interactive mode of human body sensing, so that people can immerse themselves in the virtual environment, fully create and imagine space, so as to obtain rich emotional experience.[3] Currently, the utilization of virtual reality technology in higher education primarily revolves around "human-computer interaction" capitalizing on the strengths and unique aspects of VR to fundamentally drive the high-quality advancement of higher education institutions. VR is characterized by several key features: interactivity, immersion, the creation of virtual environments, and multi-sensory feedback. Interactivity refers to the capability of VR technology to enable users to engage with the virtual setting through an array of input mechanisms, including head-mounted displays and gloves, facilitating direct manipulation and discovery within the virtual space.

Immersion refers to the virtual experience created by VR technology through visual, auditory and even tactile feedback, which gives users a strong sense of immersion. This immersion is achieved through highly realistic three-dimensional images, stereo sound effects and accurate motion tracking technology.[4] Virtual environment construction means that virtual reality technology needs to build a credible virtual environment, which includes the establishment of three-dimensional model, the rendering of the scene and the simulation of physical rules. Multi-sensory feedback means that in addition to vision and hearing, in order to enhance the reality of virtual reality, tactile, balance and other sensory feedback will be introduced. The characteristics and influencing factors of virtual reality technology are shown in table 1.

Table 1. Characteristics and influencing factors of virtual reality technology

Principle	Description	Influencing factors
Interactivity	Allow users to interact with the virtual environment	Type and quality of input equipment
Immersion	Provide users with an immersive experience	Image and sound quality, motion tracking technology
Virtual environment construction	Create realistic 3D virtual worlds	Complexity of 3D models, rendering techniques
Multisensory feedback	Increase the real feeling of the user	Haptic feedback device, balance control system

Disadvantages of Traditional Teaching Model

The contradiction between the traditional education mode of exquisite workmanship and the modern education demand of large capacity and fast rhythm is very obvious. In terms of information media, traditional textbooks are mainly paper-based printed materials, which not only have small storage capacity, but also have a single form and lack of interaction, which is not conducive to timely tracking and updating of scientific and technological information.[5] In terms of teaching effect, the traditional teaching method is a one-way indoctrination of teachers and students, which is not conducive to giving full play to student's subjective initiative. Although the traditional teaching mode has certain advantages in resource allocation and teaching management, it also has many limitations. For example, although face-to-face communication helps to deepen the interaction between teachers and students, it is difficult to meet the individual learning needs of all students due to the limitation of time and space.

At the same time, over-reliance on paper materials also limits the diversity and interaction of teaching content, which is particularly prominent in today's rapid development of information technology. In the actual teaching, teachers often adopt the teaching method to transfer knowledge. Although this method helps to ensure the integrity of the teaching content, it may also lead to the passive participation of students and reduce their interest in learning and effectiveness. Therefore, although the traditional teaching mode still has its value in some aspects, in the current higher education, more and more educators begin to explore more flexible and interactive teaching methods in order to enhance the teaching effect and students' learning experience.

Advantages of Virtual Reality Teaching Model

Virtual Reality can furnish students with an encompassing educational setting that aids in enhancing their comprehension and proficiency in intricate subjects. For instance, within the medical field, VR can replicate surgical operations, enabling students to rehearse in a secure virtual setting. In the experimental training process, the traditional experimental procedures are cumbersome, the equipment is expensive, and it consumes a lot of energy and raw materials.[6] Under specific circumstances, it may be invisible, inaccessible, non-decomposable, or even dangerous, and the teaching effect is not good. These are the important problems faced by the current teaching reform. The emergence and application of virtual reality technology provide the key to solve this kind of problem. By using virtual reality technology, a large amount of information can be used as teaching materials, which can be displayed more intuitively and timely in front of students, so that students

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can grasp it more actively and firmly. By using virtual reality technology, experimental equipment can be continuously updated and repeatedly used, which can not only reduce the input of experimental instruments, but also reduce energy consumption.

Virtual reality technology facilitates the translation of students' virtual learning experiences into real-world applications by offering a wealth of sensory cues and comprehensive feedback channels, aligning with the principles of contextual learning. The incorporation of VR technology can also activate students' sensory capabilities, ignite their passion for learning, bolster their drive to learn, and enhance the quality of education. Classroom data indicates that RMO2P has the potential to be adopted or adapted for teaching oral presentation skills in similar ESL contexts.[7] VR technology has been implemented in educational and training settings across aviation, space exploration, medicine, architecture, and nuclear energy sectors. As VR technology continues to advance, the landscape of higher education is poised to experience profound and unprecedented transformations.[8]

RESULTS

Experimental Teaching

Virtual reality technology has brought revolutionary changes to higher education, especially in experimental teaching. There are some problems in traditional experimental teaching, such as limited equipment, limited experimental materials, and some experimental projects cannot be carried out. Virtual reality technology can provide more abundant experimental scenes and experimental projects through the construction of virtual laboratory.[9] Students can carry out simulation experiments in the virtual environment, and master the experimental methods and principles through interactive operation and observation. This approach not only minimizes the expenses and safety hazards associated with experiments but also offers increased opportunities for hands-on practice, fostering the development of students' practical skills and problem-solving capabilities. In higher education, it is essential to develop students' practical skills across various disciplines, often involving "experimental operations." Some of these operations are high-risk experiments. To safeguard students while fulfilling educational requirements, it is imperative to employ virtual reality technology to establish virtual labs. This includes conducting experiments such as dissections, combustion, and explosions, which are intense and hazardous.[10]

Implementing this technology in university and college education can fulfill the teaching objectives of constructivism and situated cognition, as well as intelligent media-based teaching. It can also provide students with realistic simulated scenarios to establish an interactive learning environment that combines knowledge and practice. This allows students to gain a comprehensive understanding and mastery of both knowledge and skills through virtual observation, manipulation, and training. Using virtual reality technology to build a virtual laboratory, on the one hand, students can observe and understand the experiment, at the same time, they can also participate in the virtual experiment scene, expand innovative thinking in an all-round way, and effectively improve learning efficiency.

Immersive Experience

Digital venue navigation is a key component of virtual reality technology and stands as a technical initiative that is in high demand within the context of higher education instruction. The creation of these digital venues primarily leverages Web 3D technology, in tandem with big data technology, to develop the entire system. This is done in accordance with the practical requirements of higher education teaching to establish immersive and inventive virtual digital venues. The aim is to deliver realistic educational experiences to students, enabling them to fully engage in a virtual setting. Students are encouraged to undertake observational, educational, and exploratory activities within this environment, thereby igniting their interest and enhancing their self-directed learning efficiency. Furthermore, in the domain of higher education teaching, educators can harness computer technology and Web3D technology to craft diverse digital environments that reflect the unique attributes of various disciplines.

Examples include digital museum spaces, urban landscapes, and campus environments. These settings are designed to guide students through various roles and scenes, allowing them to gain authentic experiences and insights through these virtual constructs.[11] This approach is intended to boost students' learning efficiency, broaden their creative thinking, and drive an overall advancement in the quality of higher education teaching, aligning with the developmental goals of integrating virtual reality with educational and pedagogical practices. The application of virtual reality technology is also extensive in the sphere of vocational skills training. For instance, in medical education, this technology can replicate surgical scenarios, enabling students to conduct virtual surgeries, thereby refining their surgical techniques and decision-making capabilities. In engineering education, virtual reality can simulate the operation and maintenance of intricate machinery, allowing students to operate within a virtual setting acquire the necessary skills for real-world tasks. The integration of virtual reality technology makes vocational skills training more adaptable and productive, enhancing students'

proficiency levels and their competitiveness in the job market.[12]

Simulation Training

Virtual reality technology has revolutionized the simulation training sector within higher education. Simulation training serves as a hands-on learning approach that complements theoretical study. It primarily employs the multifaceted environments created through VR technology to educate students, such as educational and training zones, three-dimensional military culture simulation fields, historical exhibition halls, and outdoor landscape simulation areas. These are all achieved using 3D interactive technology in conjunction with various internet technologies. It facilitates educators in leading students through practical operations and training, where wearing 3D glasses and helmets and manipulating controls allows for human-computer interaction. This enables students to experience realistic scenarios and to engage in diverse training exercises. Coupled with the theoretical knowledge provided by teachers, this approach not only enhances students' practical skills but also aligns with the evolving demands of modern educational reforms.[13]

The necessity for innovation in the teaching model that integrates theory with practice is met by VR technology, which can design a multitude of simulation training scenarios. For instance, in higher education, students can undergo driving skills training through VR technology, which constructs a simulated environment. Through auditory, visual, and tactile senses, students gain authentic experiences and complete training in a secure simulated driving setting.[14] This model transcends the constraints of time and space, enabling students to access the most current knowledge and skills at any time and from any location. For example, medical students can perform surgical procedure simulations, engineering students can engage in hands-on operations of intricate designs within a VR environment, and management students can simulate the process of managing a business through VR.

Application of Virtual Reality Technology in Medical Education

With the development of science and technology, virtual reality technology has been widely used in the field of medical education.[15] By simulating the real medical environment and surgical process, this technology greatly enriches the learning resources of medical students and improves the teaching effect. This section will elaborate on the specific application cases, teaching modes and changes brought about by virtual reality technology. In medical education, virtual reality technology is mainly used in anatomy, clinical skills training, surgical simulation and other aspects. Among them, anatomy is the basis of medical education, and traditional anatomy teaching relies on cadavers or specimens, which is not only costly, but also limited by the availability of resources. Virtual reality technology reconstructs human body structure through three-dimensional model, which enables students to learn human anatomy in a risk-free environment, and effectively improves learning efficiency and interest. In addition, clinical skills training is another important part of medical education. Traditional training methods often need to simulate real patients in the laboratory, which requires more resources and time.[16]

The use of virtual reality technology can create a variety of disease simulation scenarios, so that students can practice in a virtual environment, such as suturing, catheterization, etc., which can not only save resources, but also provide immediate feedback according to student's performance, and promote the rapid improvement of skills.[17] In the aspect of surgical simulation, virtual reality technology provides a nearly real surgical environment, including the operation of surgical instruments, the arrangement of surgical procedures and so on. Students can practice specific surgical techniques repeatedly without any risk until they master them. This kind of simulation training is of great significance for improving students' surgical skills and decision-making ability.

Application of Virtual Reality Technology in Engineering Education

With the continuous development and maturity of virtual reality technology, its application in the field of engineering education has gradually increased, providing students with a more intuitive and interactive learning experience.[18] By simulating the real engineering environment and operation process, virtual reality technology can help students better understand complex engineering concepts and principles, and improve their learning efficiency and interest. Students can use virtual reality technology for three-dimensional modelling and design, which can not only improve the accuracy of the design, but also allow students to explore and modify the design freely without physical constraints. Through the virtual reality technology, students can carry out various engineering experiments in the virtual environment, such as mechanical movement, circuit testing, etc. These experiments are safe and economical, and greatly reduce the resource consumption of traditional experiments.

Virtual reality technology can simulate the running state of engineering system, help students master the skills of fault diagnosis and analysis, and improve the ability of problem solving. For some high-risk engineering operations, such as working at heights and handling dangerous chemicals, virtual reality technology can provide a safe simulation environment to ensure the safety of students. In specialties such as architecture

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and civil engineering, VR technology can help students improve their spatial cognition, which is essential for understanding and designing complex structures.[19] The use of VR technology for simulation training can significantly reduce the cost and risk of practical operation, enabling students to learn and practice without physical equipment. VR technology provides a platform for engineering education, on which students and teachers can conduct innovative design and research, and promote the development of new technologies and solutions. VR technology can provide personalized learning paths according to each student's learning progress and interests, so as to meet the needs of different students.

Application of Virtual Reality Technology in Management Education

Management education is an important part of higher education, which aims to cultivate students' management ability and leadership. With the development of virtual reality technology, its application in management education has attracted more and more attention. Through virtual reality technology, a simulated business environment can be created to enable students to conduct decision-making training without risk, thus improving their management and decision-making ability. In management education, virtual reality technology is mainly used in case analysis, role play, team cooperation and so on. Through these applications, students can deeply understand management theory and apply it to practical situations. Using VR technology, students can make decisions in a simulated business environment and immediately see the impact of the decision results, which helps them understand the decision-making process and consequences. Through a virtual reality environment, students can experience different leadership styles and management scenarios to practice and improve leadership without real risk.[20] VR can create emergency and crisis scenarios that allow students to learn how to respond to and manage a crisis in a controlled environment. Engaging with colleagues and customers in a virtual environment can help students improve their communication and negotiation skills. VR technology can simulate the business environment of different cultural backgrounds, so that students can learn and understand cultural differences in the context of globalization. Students can practice in virtual companies, experience real workflow and business operations, and prepare for their future career. Some scholars have proposed a pedagogical model for new media art in higher education that aims to promote digital preservation and the promotion of intangible cultural heritage, aligning with values of innovation and entrepreneurship.[21] Through virtual reality, students can participate in complex project management and learn how to coordinate resources, manage time and control budgets. Virtual reality technology not only improves the interactivity and practicality of management education, but also provides students with a flexible, dynamic and attractive learning platform to help them prepare for the future management career. With the continuous development and improvement of technology, the application of virtual reality in management education will become more extensive and in-depth.

Application of Virtual Reality Technology in Physical Education

With the rapid development of virtual reality technology, its role in college physical education has become increasingly prominent, and it is gradually changing the traditional mode of physical education. Virtual reality technology provides students with an immersive sports learning platform by creating a highly simulated three-dimensional virtual environment. Students can experience the excitement of a real competition and try and practice all kinds of difficult movements without the risk of injury. By using virtual reality technology, students can train their sports skills such as basketball shooting, football shooting, track and field race in a space without physical restrictions. With the help of VR technology, these training programs can be presented in a more intuitive and interactive way, so that students can get close to the real experience in vision, hearing and even touch. For example, in basketball shooting training, students can see the basket and court through VR helmet, simulate shooting action through hand-held controller, and the system will provide immediate feedback according to students' action to help them adjust shooting posture and strength, so as to improve the accuracy and success rate of action. In addition, virtual reality technology can customize different training plans and difficulty levels according to students' individual needs. Whether beginners or high-level athletes, they can find their own training content. This personalized training method can not only stimulate students' interest in learning, but also help them master sports skills faster and improve training efficiency. In competitive sports, the application of virtual reality technology also shows great potential. It can simulate the real competition scene, so that students can have a deeper understanding and adaptation of the competition environment and the characteristics of the opponents before the competition. This psychological preparation is essential to improve the performance of students. By simulating the competition repeatedly in the virtual environment, students can enhance their psychological quality and improve their ability to cope with pressure, so as to play a better level in the competition.

DISCUSSION

Teaching Effect Analysis of Virtual Reality Technology in Medical Education

In the domain of medical education, virtual reality technology has emerged as a pivotal tool for enhancing

the caliber and productivity of instruction.[22] By replicating authentic clinical settings, VR technology can boost students' enthusiasm for learning and their proficiency in clinical techniques. This section will evaluate the instructional impact of VR technology in medical education across three key dimensions: students' knowledge acquisition, skill execution, and emotional disposition. The subjects of this study were 50 clinical medical students, who were randomly assigned to either an experimental group or a control group. The experimental group students utilized a virtual lab to perform experiments and engage in a range of medical teachings within a virtual setting. In contrast, the control group students continued to use a traditional lab for their experiments, providing a comparative analysis with the experimental group. The findings are presented in table 2.

Table 2. Teaching effect of virtual reality technology in medical education

Evaluation indicators	Before traditional teaching	After Virtual Reality Teaching
Knowledge mastery rate	73,2 %	91,1 %
Skill operation level	64,1 %	88,6 %
Emotional attitude improvement	60,9 %	91,6 %

According to the above table data, it can be seen that after using virtual reality technology for medical education, students' knowledge mastery rate, skill operation level and emotional attitude have been significantly improved. This indicates that virtual reality technology offers a positive educational impact in medical education, significantly boosting students' learning efficiency and the standard of instruction. Comparative analysis reveals that VR's application in medical education, particularly regarding knowledge acquisition and skill execution, exerts a beneficial influence on students. Moreover, the notable enhancement in emotional attitude confirms that VR can deliver a more authentic learning experience and augment students' motivation and contentment.[23] The integration of VR technology in medical education not only enhances students' knowledge and skills but also elevates their emotional attitude, thereby fulfilling the goal of enhancing the overall educational outcome.

Teaching Effect Analysis of Virtual Reality Technology in Engineering Education

When discussing the application of virtual reality technology in engineering education and its teaching effect, this study collects the data of engineering teaching using VR technology in many universities. By comparing and analyzing these data, we can more intuitively understand the specific impact of virtual reality technology on improving student's learning efficiency and enhancing their interest in learning.[24]

Table 3. Teaching effect of virtual reality technology in engineering education

Evaluation indicators	Before traditional teaching	After Virtual Reality Teaching
Student satisfaction	70,9 %	81,6 %
Mastery of knowledge	64,6 %	80,2 %
Practical ability	70,2 %	88,6 %

From the table 3, it can be seen that after the introduction of virtual reality technology, students' satisfaction, knowledge mastery and practical ability have been significantly improved. Participants from both the experimental and control groups were subjected to a knowledge assessment that encompassed the engineering principles and laboratory techniques pertinent to the experiment. The assessment outcomes indicate that the experimental group's students achieved an average score of 80,2 %, whereas the control group's students attained an average of 64,6 %. The experimental group outperformed the control group notably in the realms of grasping engineering concepts and honing experimental operational skills. Notably, in practical capability, the average improvement soared to 88,6 %, signifying that VR technology significantly bolstered the students' practical skills and problem-solving capabilities.[25] The utilization of VR technology in engineering education not only augments students' learning efficiency but also ignites their passion for learning and offers them a more extensive and authentic learning experience. Nevertheless, to maximize the benefits of VR technology in engineering education, educators and educational institutions must devote more resources to pertinent training and continually refresh and refine the VR teaching content and instruments. Looking ahead, as technology continues to advance and educational paradigms evolve, VR technology is poised to assume an increasingly pivotal role within the sphere of higher education.

Teaching Effect Analysis of Virtual Reality Technology in Management Education

The incorporation of virtual reality technology within the management education sector furnishes students with an engaging learning setting, allowing them to comprehend and grasp management theories and practices through the simulation of real-life situations. This section will evaluate the pedagogical efficacy of virtual

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reality technology in the context of management education.[26] Through a comparative analysis of conventional teaching approaches and those employing virtual reality, we gathered pertinent data and conducted a statistical review. The subjects of this study consisted of 50 management science and engineering students, who were randomly assigned to either an experimental or control group. The experimental group engaged with a virtual lab to perform experiments and undertake a range of management courses within a virtual setting. Table 4 illustrates the advancements in students' management knowledge, collaborative skills, and problem-solving capabilities following the application of virtual reality technology.[27]

Table 4. Teaching effect of virtual reality technology in management education

Evaluation indicators	Before traditional teaching	After Virtual Reality Teaching
Master management knowledge	71,0 %	92,2 %
Teamwork skills	65,2 %	854 %
Problem solving ability	73,3 %	93,5 %

From the above data, we can see that the introduction of virtual reality technology has significantly improved the learning effect of students in management education. Especially in terms of management knowledge and problem-solving ability, student's performance has been significantly improved after using virtual reality technology. In addition, virtual reality technology has enhanced students' sense of participation and interest. Through the simulated business environment and decision-making process, students can understand management theory more intuitively and apply it to practical situations. This combination of interaction and practicality greatly promotes the development of students' active learning and innovative thinking. The application of virtual reality technology in management education not only improves the teaching effect, but also provides a more abundant and dynamic learning platform for students. In the future, with the continuous progress of technology and the renewal of educational concepts, the application of virtual reality technology in the field of management education will be more extensive and in-depth.

Teaching Effect Analysis of Virtual Reality Technology in Physical Education

To conduct an in-depth examination of the impact of virtual reality technology in the context of college physical education instruction, this research has gathered and scrutinized data from numerous institutions of higher learning that have implemented VR technology within their physical education curriculum. By engaging in a comparative analysis of this data, we are able to discern the precise influence that virtual reality technology wields in bolstering students' physical abilities and igniting their passion for learning. Table 5 delineates the influence exerted by virtual reality technology in the domain of physical education.

Table 5. The effect of virtual reality technology in physical education

Evaluation indicators	Before traditional teaching	After Virtual Reality Teaching
Student satisfaction	72,3 %	85,4 %
Skill mastery	67,5 %	83,1 %
Competitive performance	69,8 %	87,3 %

Upon reviewing the table provided, it is evident that the incorporation of virtual reality technology has markedly enhanced student contentment, proficiency in skills, and competitive execution. This trend is notably pronounced in the sphere of physical education, where virtual reality offers an innovative learning platform that facilitates a more direct and engaging method for students to acquire athletic abilities. Evaluations of athletic skills were undertaken among the experimental and control group participants, encompassing disciplines such as basketball and soccer. The outcomes of these assessments revealed that the experimental group's students achieved an average skill proficiency rate of 83,1 %, contrasting with the control group's 67,5 %. This pronounced disparity underscores the substantial benefits of virtual reality technology in advancing students' adeptness and proficiency in sports skills. The experimental group's students notably outperformed the control group in both motor skill acquisition and competitive performance metrics. Notably, in competitive execution, the experimental group's students exhibited an average improvement of 87,3 %, which underscores the pivotal role that virtual reality technology plays in bolstering students' competitive prowess and mental fortitude. Through the simulation of authentic competitive scenarios within a virtual setting, students are positioned to psychologically acclimate to the pressures of competition more effectively, thereby elevating their competitive readiness and achieving enhanced performance in actual contests.

The application of virtual reality technology in physical education teaching in universities can not only improve students' learning efficiency, but also stimulate their enthusiasm for learning, providing them with a

richer and more realistic sports experience. This immersive learning environment allows students to engage in skill training and competitive simulations in a safe and stress-free environment, thereby facing real-world challenges with greater confidence. With the continuous development of technology and innovation in educational concepts, we have reason to believe that virtual reality technology will play an increasingly important role in future physical education teaching, providing students with a richer, more efficient, and personalized learning experience.

CONCLUSIONS

Virtual reality technology has brought a new and highly interactive way of learning for higher education. It can create virtual scenes close to reality or beyond reality, so that students can practice without safety concerns, which is very important to stimulate student's enthusiasm for learning and improve their practical skills. The introduction of this technology, especially its interactive and immersive experience, has brought innovation to the traditional education model. Compared with traditional education mode, virtual reality technology can better meet students' personalized learning needs, and encourage them to actively explore and learn independently. From the empirical analysis of teaching effect, virtual reality technology has shown high teaching effect and efficiency in the fields of medicine, engineering, management education and physical education. Especially in the field of medical education, virtual reality technology can provide a very realistic anatomical learning environment to help students master complex medical knowledge and skills more effectively.

Future research should focus on the sustainable development of virtual reality technology in higher education, including reducing costs, improving the ease of use of technology and developing more teaching content and tools for different disciplines and professions. At the same time, we should strengthen the tracking research on the long-term teaching effect of virtual reality technology to provide more solid data support for educational decision-making.

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