Applications of Teaching Based on Virtual Reality in Agro-Pastoralism Areas

Zhonglin Ye, State Key Laboratory of Tibetan Intelligent Information Processing and Application, Qinghai Normal University, China*
Yanlin Yang, State Key Laboratory of Tibetan Intelligent Information Processing and Application, Qinghai Normal University, China
Lei Meng, State Key Laboratory of Tibetan Intelligent Information Processing and Application, Qinghai Normal University, China
Gege Li, State Key Laboratory of Tibetan Intelligent Information Processing and Application, Qinghai Normal University, China
Zhaoyang Wang, State Key Laboratory of Tibetan Intelligent Information Processing and Application, Qinghai Normal University, China
Haixing Zhao, State Key Laboratory of Tibetan Intelligent Information Processing and Application, Qinghai Normal University, China

ABSTRACT

This article first put forward the educational application of immersive virtual laboratories for the problems of poor spatial thinking ability and weak hands-on operation ability. Second, aiming at the problems of a lack of excellent backbone teachers and insufficient educational information equipment, a Tibetan-Chinese bilingual immersion virtual basic teaching system suitable for students in pastoral areas has been developed to complement the teaching of teachers in remote areas. Third, the application of virtual gymnasiums is proposed to reduce the physical discomfort of students under harsh conditions. And then the application of virtual vocational technical training is proposed for poor employment situations in agro-pastoralism areas. Finally, the Tibetan-Chinese bilingual immersive virtual basic teaching system developed for pastoral students was put into use for a short period of time in the farming and pastoral schools and was well received by the pastoral students, and the teachers also gave feedback that the system has now improved at least the concentration of the student.

KEYWORDS

Agro-Pastoralism Areas, Bilingual Immersion Virtual Basic Teaching System, Bilingual Teaching Mode, Immersive Virtual Laboratories, National Educational Informatization, Virtual Reality

INTRODUCTION

Virtual reality (VR) (Zhao, 2017) was first proposed by Lanier in 1989. Virtual reality is to generate a realistic three-dimensional perceptual world of sight, sound, touch, or smell that allows users to navigate and interact with virtual world objects from their vision using natural skills and certain devices.

As shown in Figure 1, virtual reality has three basic characteristics (Burdea & Coiffet, 2003): multisensory, immersion, and interactivity. Multisensory refers to visual perception, auditory, force,
haptic, kinesthetic perception, and taste and smell perception. Immersion refers to the degree of realism the user feels in the virtual environment. The more real, the more immersion, the greater the sensation that they are in the real world. Finally, interactivity refers to the extent to which the user can manipulate objects in the virtual environment and receive feedback from the virtual environment.

As shown in Figure 2, a virtual reality system comprises five main components that explain interactions with the virtual environment.

The participant activates input facilities, such as helmets and gloves, to provide input signals for the computer. The virtual reality software receives the input signals from trackers and sensors. It interprets them, updates the virtual environment database, adjusts the virtual environment scene, and passes the 3D image of the viewpoint and other information to the corresponding output devices (such as helmet display and data gloves) to give the user a virtualized, sensory effect.

Virtual reality technology comprises elements such as graphics and image technology, multimedia technology, interaction technology, network technology, 3D display technology, and simulation technology (Li et al., 2015). Virtual reality technology uses computers to generate realistic 3D visual, auditory, olfactory, and other senses. Through devices, it places the user in the 3D environment the computer represents so that the user can naturally experience and interact with the virtual reality world. It creates a sense of “immersion.” Virtual reality technology creates virtual reality using
computers. Virtual reality is one of the key development disciplines of the 21st century and one of the most important technologies affecting people’s lives.

Virtual reality technology has progressed rapidly with information technology advances. It has been widely adopted in the military (Xu et al., 2017), education (Chen et al., 2020, Yan et al., 2019, McGovern et al., 2020), medicine (Chen et al., 2020, Shen et al., 2020), film and television (Li, 2022), business (Lei & Zhou, 2020), restoration of case scenes (Li et al., 2015), psychology (Hu et al., 2020), entertainment (He, 2022), engineering training (Wei et al., 2018, Sun et al., 2019), scientific research (Luo et al., 2021), manufacturing (Sekaran et al., 2021, Chen et al., 2021), and other fields. For example, virtual reality allows users to enjoy an immersive gaming experience from a first perspective in terms of entertainment, such as watching a movie on the moon or performing with a singer on stage. In terms of tourism, we can create immersive tourism locations through virtual reality, and users can choose locations anytime and anywhere for virtual tourism to achieve the feel of “mix the spurious with the genuine.” Virtual medicine can assist real-life anatomy and surgery by constantly simulating anatomy, saving medical resources, and avoiding surgical errors.

The traditional teaching mode is characterized by “transmit-receive.” Teachers are the masters of the entire teaching process, and students are the object of imparting knowledge and passive recipients of external stimuli. Textbooks are the only learning content for students and the principal source of knowledge for students (Wang, 2018). Most of the traditional teaching mode is based on the existing experience of teachers, and there are problems such as a single teaching form, a single learning method, a single goal, a single problem, a single evaluation, and a single process. Single-paper textbooks, one-way indoctrination teaching methods, and carefully crafted teaching content seriously affect the improvement of teaching quality. Because of the limitations of teaching equipment and teaching venues, the traditional education model has been difficult to adapt to and meet the needs of modern education. Although there are some traditional education platforms, their development has reached the upper limit, and we cannot ignore many problems. For example, PPT and video teaching are no longer novel, and students’ concentration is low; the teaching methods are boring, and students do not want to listen. Limited by time, space, and equipment, the flexibility of teaching methods is low, and it is difficult for teaching and learning to resonate, which hinders innovative thinking.

The emergence and application of virtual reality technology solves these problems. The practices prove that education and teaching based on virtual reality technology are more adaptable to the modern education needs of high-capacity and fast-paced education. As a result, educators and researchers in related fields attach great importance to virtual reality technology, which vigorously promotes its application in education and teaching. The traditional learning model is limited by time and space; students can only receive knowledge at a fixed time and place. The application of virtual reality technology in modern education can enhance human-computer interaction, which encourages students to engage in independent learning and research exploration with greater enthusiasm, and immersing learners in virtual reality environments can stimulate motivation, enhance the learning experience and realize contextual learning. Some high-cost or high-risk experiments are difficult to operate in real life. Using virtual reality technology can show many inconvenient or difficult experiments to operate in real labs, which visualizes some profound and obscure knowledge for the students. This visualization stimulates students’ interest in learning and deepens their understanding and memory of knowledge in realistic learning scenarios. For example, some chemical experiments have the risks of explosions and combustion, and the simulation of experimental procedures can allow students to conduct these high-risk experiments. For example, it is difficult for students to understand the principles of crustal movement in geography, but students can gain a deep understanding of the essential content by observing crustal movement if they model the experiment using virtual reality technology.

Another example is that the application problem of sailing distance in mathematics can be simulated through virtual reality. The virtual scenes allow students to feel the relationship between the downwind and upwind speeds. Finally, they can understand abstract applications more easily and enhance their spatial thinking ability.
Beijing, Shanghai, Guangzhou, Sichuan, and other provinces have attempted to introduce virtual reality technology in primary and secondary schools to cultivate students’ science literacy and spatial thinking skills at an early age. With the support of virtual reality technology, learners’ learning experience in the online platform is similar to “being in the real world.” Learners can follow their learning ideas and learning progress to select teaching content and conversation context independently, which greatly improves the autonomy of learning and, thus, the efficiency of learning. However, the less developed western regions’ economic, cultural, technological, and educational levels are far behind those in other provinces and regions. The situation is especially acute in remote pastoral areas, where there is a lack of colorful teaching resources, a single form of teaching, low scientific literacy among students, educational facilities and equipment that do not meet the basic standards set by the state, and a lack of excellent backbone teachers (Kong, 2012, Zhang et al., 2014, Ma, 2001, Liu et al., 2021). The reasons and problems regarding the lagging science education in ethnic areas and the low and lagging learning level of ethnic students in science have attracted the attention of many scholars, who have explored effective ways to improve the situation, but the problem has not truly been solved. Therefore, it is urgent to use the new mode of “artificial intelligence + education” to optimize the teaching and experimental environment and break through the traditional teaching mode to solve the above teaching bottlenecks and accelerate the development of ethnic education informatization.

Considering the current educational situation and teaching mode in remote pastoral areas, this paper aims to conduct a preliminary study on ethnic education in remote pastoral areas using virtual reality technology. Through a series of preliminary studies, this paper proposes some innovative applications that promote pastoral education development to create new teaching models, optimize the teaching and experimental environment, break through traditional teaching models, and play a certain role in teaching teachers in remote areas. This paper proposes corresponding application and innovation measures for remote farming and pastoral areas. First, it suggests the educational application of an immersive virtual laboratory to address students’ poor subject literacy, poor spatial thinking ability, and weak manual operation ability in farming and pastoral areas. Second, we propose the educational application of an immersive virtual laboratory because of the lack of excellent key teachers and a single teaching form. Third, this paper proposes the application of virtual gymnasiums to supplement the teaching of teachers in remote areas, reduce the physical discomfort of students under bad conditions, and solve the problem of bad weather in farming and pastoral areas, as well as the problem of poor employment situations in farming and pastoral areas. Finally, the application of virtual vocational and technical training is proposed. For a short time, students in pastoral areas have consistently praised the pastoral areas for the developed Tibetan-Chinese immersive virtual basic teaching system. Teachers also reported that the concentration of students improved after using the system.

RELATED WORK

Virtual reality technology initially appeared in the United States in the 1990s. The United States applied virtual reality technology to education and the military, followed by the United Kingdom, Germany, Sweden, and other European countries. Research on virtual reality technology in China started late, but many achievements have been made in virtual reality. In recent years, virtual reality has become the focus of social attention. After Facebook acquired Oculus, a maker of virtual reality helmets, for 2 billion USD, the market value of virtual reality increased instantly and initiated a shift over the entire social industry chain. Until now, virtual reality technology has attracted much attention in global technology enterprises; for example, Sony, Oculus, HTC, and others have launched new VR headsets, Alibaba set up a VR lab, and BAT also enters the VR field comprehensively. Through the “White Paper on Virtual Reality Industry” released by the Ministry of Industry and Information Technology in 2016, it can be found that the market transaction scale of China’s virtual reality industry was 1.54 billion yuan in 2015, and the market transaction scale is expected to reach 10 billion yuan
in 2022. In particular, Facebook announced in 2021 that it would change its name to Meta and enter the meta-universe (Zhang & Su, 2021, Mystakidis, 2022), which attracted widespread attention from the scientific and investment communities and provides a good model for the future transformation of the global digital economy.

The application of virtual reality technology in teaching can help students have a more visual and better understanding of knowledge. For example, Zakharov (2020) explores the learning effect of virtual reality technology in geography classes. Through the comparative experiments, they found that using VR technology can make students pay more attention in class. Shannon and Lateefah (2019) applied virtual reality technology to a mathematical class for fifth-grade students at Cochrane Elementary School in Gavin, Kentucky. It shows that virtual reality can help students calculate a cube’s volume and gives students an intuitive learning experience. Iquira et al. (2019) provide a virtual physics lab space for 86 current university students, and it can be found that physics teaching in a virtual space provides a safe operating environment for students to repeat relevant physics experiments at any moment without damaging the equipment. Finally, Petrov et al. (2020) select a public secondary school to explore the effects of two different teaching models: “explore artistic works in the classroom” and “explore artistic works by virtual reality.” The experimental results show that the team using virtual reality technology meets the personalized learning needs and inspires the students’ creativity to a great extent. Birt and Cowling (2017) introduce virtual reality technology into the classroom by modeling physical devices, such as routers and switches, making it easy for students to understand how abstract theoretical data operate on devices. In addition, Tolentino et al. (2009) argue that students who participate in a virtual reality classroom significantly improve their spatial reasoning skills in a teaching experiment. There are also domestic efforts related to the application of virtual reality technology in rural education and primary and secondary school education. For example, Rao and Yan (2022) apply virtual reality to junior high school physics teaching, where students can interactively connect with virtual things to gain both figurative and logical thinking skills.

Through the above applications of virtual reality in the teaching process, we can find that it can increase students’ interest in learning and encourage their imagination, creativity, and spatial reasoning ability through its interactivity and unparalleled virtual space immersion. Science education, classroom interaction, and extracurricular activities are the main application directions of virtual reality technology in primary and secondary school education. However, because of the high requirements of virtual reality technology for equipment and technology, eastern large cities and developed eastern regions in China are the main places where virtual reality technology is applied in primary and secondary schools. The regional imbalance of educational resources is the key factor limiting the role of virtual reality technology in primary and secondary school education (Guo, 2022).

The spatial thinking ability of pastoral students is poorer, and their science literacy is lower, which can be seen and verified from the science subjects of students’ entrance exams in recent years. Therefore, it is a problem how to improve the spatial thinking ability of pastoral students and break the imbalance of educational resources between the eastern and western regions.

In order to support teaching in remote pastoral areas and improve the teaching level in pastoral areas, there are efforts to increase the richness of teaching resources in pastoral areas through master classroom, distance learning, and counterpart support. However, pastoral students have a poorer learning foundation, so students benefit from direct exposure to high-speed and efficient master classrooms. But, to a certain extent, it will discourage pastoral students from learning. Virtual reality technology is the most direct and effective way to improve students’ spatial thinking and hands-on skills, but there is no case for applying virtual reality technology to teaching in agricultural and pastoral areas. Therefore, this paper makes a preliminary exploration of ethnic education intelligence and adopts virtual reality technology to build a teaching model and application that meets the current teaching situation in pastoral areas and complements the teaching of pastoral teachers. It puts the developed Tibetan-Chinese bilingual immersive virtual basic teaching system suitable for pastoral students into practical application in schools for pastoral areas, which pastoral students have received
well. Teachers also give relevant feedbacks that the system has now at least improved students’ concentration and imagination.

VIRTUAL REALITY KEY TECHNOLOGIES

Innovative virtual reality technology contains three kinds of technologies: virtual reality (VR), augmented reality (AR), and mixed reality (MR) Technologies.

Virtual Reality Technology

Virtual reality technology mainly involves creating an immersive virtual environment. Users interact with objects in the virtual world through external devices, such as head-mounted displays and CAVEs to achieve an immersive experience. VR technology is presented as immersion, suitable for open and free teaching spaces. Students can operate arbitrarily in the virtual space, which is conducive to stimulating students’ creativity. Head-mounted displays mainly include Oculus Rift, HTC VIVE, and Sony Morpheus. HTC Vive can bring the most complete and comprehensive virtual reality experience. HTC Vive possesses VR experience contents, which have the characteristics of high definition and good vision. CAVE is a virtual reality display device based on projection style with high screen resolution, strong immersion, and interaction. CAVE can realize the stereoscopic projection effect through 3D glasses, giving viewers an incredible visual impact and immersive experience in a 3D immersive space.

Augmented Reality Technology

Augmented reality contains three principal features. First, it has the characteristics of virtuality-reality fusion; then, it has real-time interactivity, and finally, a 3D tracking function. Computers generate real-time 3D information to enhance the user’s real-world perception. Augmented reality technology places the virtual object at the user’s desired location in the real environment using external devices, such as tablets, mobile phones, or Z Space, to place the user in this fused environment. The world the user perceives is a unique fusion of virtuality-reality, and the user can interact with the augmented reality environment using these devices, such as tablets. Z Space, a new 3D display developed by Infinite Z in California, brings innovation to computer gaming and AR by tracking the rotation of the user’s head and the movement of their hands, constantly adjusting the 3D image they see in a desktop-style presentation. Z Space is equipped with a special pen with a built-in sensor, which can track the movement of objects in 3D space. The pen can seize a specific part of the virtual image and then move it anywhere in 3D space.

Mixed Reality Technology

Mixed reality is an interactive environment that places the user in augmented reality; it emphasizes seamless integration between the virtual and real worlds. It can conduct human-computer interaction more naturally and adjust and control the situation in time, including all VR and AR technology functions. The HoloLens and holographic projections, developed by Microsoft, use mixed reality technology. HoloLens allows users to directly slide or click the window presented by HoloLens for 3D registration. Holographic projection can operate the object through the handle in three-dimensional space.

Virtual Reality Development Process

The virtual reality technology takes Windows as the environment, Unity3D, 3DMax, and Maya as the software development platform, C# and Javascript as the software development languages, and finally, the Arduino platform is used to read the data. Figure 3 shows the virtual reality development diagram.
EXPLORING THE SPECIFIC APPLICATION OF VIRTUAL REALITY TECHNOLOGY IN PASTORAL EDUCATION

Based on long-term studies on the teaching mode and teaching status of primary and secondary schools in agro-pastoralism areas, it can be found that students in agro-pastoralism areas generally have poorer spatial thinking skills, lower science literacy, and weaker operation skills. These deficits are principally because of the lack of educational information technology equipment, excellent key teachers, and teaching mode.

According to research data, people can remember 90% of their experience, and VR devices help users significantly improve their learning. Each of the three virtual reality technologies has its strengths and weaknesses. For example, VR technology has an immersive experience that allows students to focus more; however, head-mounted displays are heavy and should not be worn for a long time, which makes students prone to vertigo. AR is a technology integrated with the real world. It is suitable for ordinary classes and is relatively light, but the training of concentration and hands-on operation ability is not comparable to VR technology. Therefore, considering the existing teaching mode and teaching status in agro-pastoralism areas, this paper proposes that they should simultaneously apply three technologies to teaching in agro-pastoralism teaching. Through different teaching purposes, different technologies should present different interactive forms, such as immersion, desk, and holographic devices, to realize the optimized integration of agro-pastoralism teaching and virtual reality technology. This paper develops a holographic virtual teaching system from the basic education model in pastoral areas, which applies to usual classes and has a sense of immersion. They mainly design content according to the classroom habits and teachers’ syllabus in agricultural and pastoral areas. The system is displayed through holographic devices, and teachers wear the main glasses and can operate the target objects through the handle. The system solves the problems of heavy head-mounted displays, easy vertigo and lack of immersion in AR technology, and can be worn for a long time.

This paper proposes and develops relevant application platforms based on agro-pastoralism’s current situation and teaching mode. This paper provides the following technology diagram to implement these application platforms, as shown in Figure 4.

Virtual Laboratory

Virtual laboratories are helpful for agro-pastoralism areas with insufficient resources and equipment, such as physics and chemistry laboratories. Students of different grades can choose the experiments independently. In the virtual laboratory, they will provide operation reminders. For example, reminders will be provided in each experimental step for the experiment in the chemical reaction between Na and water. Students can repeatedly practice in the immersive virtual laboratory until they master the experiment. A virtual laboratory breaks the limitation of a traditional laboratory in terms of time and space, reduces the safety risk, and avoids the occurrence of experimental accidents.
Holographic Virtual Teaching System

We developed the system using Windows as the environment. First, Adobe Photoshop was used for image processing of textures and maps of laboratory equipment, experimental instruments, and biological species in the virtual space. Second, 3D Max and Maya were used to build 3D models of various laboratory equipment, experimental instruments, and biological species. Then we used Unity 3D to animate the virtual scenes, such as the color changes, matches’ lighting, and bubbles’ appearance in the chemistry lab. Finally, we read external sensor signals through the Arduino electronic platform, connecting the virtual space with external devices such as head-mounted displays.

The holographic virtual teaching system divides the system into five parts according to the different responsibilities and business plans as follows. At the bottom is the classifications and contents of the course resources. The middle level is holographic virtual reality content construction, learner (student) behavior, and the virtual learning environment. The top level is evaluation and tracking. The holographic virtual teaching system is displayed through holographic equipment, and the teacher wears the main glasses and manipulates the target object through handheld terminal equipment. For example, it is difficult to have a deep impression on students just by relying on pictures and books in
a biology class to understand the structure of the human body, but the teacher can zoom-in an organ and rotate it globally and can dissect the organ by using holographic technology to create a 3D body structure. When the student wears the attached glasses, they gain the same dominant view as the teacher, which allows students to observe the 3D structure of the object more closely and thus can deepen students’ impressions. The details of the holographic virtual teaching system are as follows.

CLASSIFICATION OF RESOURCES

We must construct a complete and comprehensive subject classification tree first to provide resource classification for the entire system. The resource classification provides a basic data design paradigm for constructing holographic virtual reality contents and learner behavior. It is an important basis for designing learner behavior and constructing holographic virtual reality learning environments. The functional design of the classification must have automatically scalable programming and implementation. The key features must meet the needs of node management and node keyword management functions. In addition, the system needs to support simple authority control and user management functions for operators to maintain sub-nodes. We show the classification of resources in Figure 5.

Content Building

An abstracted holographic virtual reality scene, which is the core of content building builds the content. It uses a collaborative-oriented visual manipulation architecture and integrates the management and collaboration modules for models, scenes, people, and configurations to form a complete, universal

Figure 5. Resource classification
solution. Nonrelational data, such as 3D models, materials, textures, shader programs, skeletal animations, and documentation, voice, and video, must be abstracted and transformed into relational data. For voice and video, the key information needs to be extracted to form a connection relationship, and then it needs to classify disciplines and courses according to the classification tree. We mainly designed the content of the holographic virtual teaching system according to the classroom habits and syllabus of teachers in agro-pastoralism areas. We believe they can improve the current education situation in agro-pastoralism areas through the following five aspects.

**Holographic Physics Teaching Platform**

The holographic physics teaching platform uses VR virtualization teaching technology to provide a realistic visual learning platform for abstract physics topics. These include energy, motion, forces, matter, thermodynamics, optics, atoms, mechanics, and electricity, which are supplemented by actionable and exploratory virtual experiments to help students practically understand and master various laws of physics. For example, Figure 6 shows the interface of the sound propagation experiment on the holographic physics teaching platform, and Figure 7 shows the specific experimental interface of measuring object mass with a balance on the holographic physics teaching platform.

**Figure 6. Sound propagation experiment**

![Figure 6. Sound propagation experiment](image1)

**Figure 7. Experimental measurement of mass with a balance**

![Figure 7. Experimental measurement of mass with a balance](image2)
**Holographic Chemistry Teaching Platform**

The holographic chemistry teaching platform provides virtual reality knowledge and experiments synchronized with the chemistry syllabus for teachers and students. Students can exercise their scientific thinking and experimental investigation skills by presenting experiments and simulations. Figure 8 shows the specific operation interface of the experiment on the holographic chemistry teaching platform, an example of an alcohol lamp. Figure 9 shows the specific operation interface of the experiment on the investigation of candles and their combustion based on the holographic chemistry teaching platform.

**Holographic Biology Teaching Platform**

The holographic biology teaching platform covers the contents such as life composition, animal and plant cells, plants in the biosphere, and people in the biosphere. The platform allows students to observe the changes and reproduction of cells, viruses, and the material basis of life. Figure 10 shows the specific operation interface of the crucian carp on the holographic biology teaching platform, which can decompose and combine the organs of the crucian carp or observe a certain organ.

Figure 8. Experimentation with an alcohol lamp

![Figure 8. Experimentation with an alcohol lamp](image)

Figure 9. Experimentation with candles and their combustion

![Figure 9. Experimentation with candles and their combustion](image)
Holographic Science Teaching Platform

The holographic science teaching platform can observe the evolution of the world, the changes in galaxies, the changes in seasons, the composition of nature, the structure of the body and so on. The platform allows students to learn scientific knowledge. The platform’s purpose is to cultivate students’ scientific literacy and spatial thinking ability from an early age. Figure 11 shows the specific display interface of the body structure on the holographic science teaching platform.

Holographic Mathematics Teaching Platform

The holographic mathematics teaching platform covers basic mathematical knowledge, explanation of formulas, and cognition of geometric figures. The platform immerses students in learning difficult mathematical knowledge, logical thinking, and thinking abilities. Figure 12 shows calculating the volume of a cylinder on the holographic mathematics teaching platform.
User (Student) Behavior

The system partly uses advanced human-computer interaction to achieve teaching objectives. Students acquire knowledge and skills through autonomous interaction with the virtual environment. To match different interaction hardware, the system classifies and encapsulates students’ interaction behavior according to different types of courses and teaching aims to form an abstract interaction layer and its interfaces.

Holographic Learning Environment

This part is the system’s core function; it combines the data from the other four parts to create the ultimate independent learning environment. The holographic interactive system, based on virtual teaching, solves the problem of dizziness for students when wearing helmets and realizes a multi-person interactive, immersive virtual teaching technology.

Tracking and Evaluation

Traditional teaching evaluation is performed by teachers who correct students’ homework and examination papers or give grades based on subjective impressions, which has certain drawbacks. With the advancement of teaching information and the popularity of computers, it has become possible to conduct teaching assessments in a virtual environment. Teachers can keep track of each student’s learning records throughout the courses, including viewing the student’s learning report, the number of course visits, and the student’s participation in a particular teaching module. The assessment content is subdivided into four areas: course content learning, participation in interactive communication, examinations and works, and extracurricular resource learning. Finally, a personal learning assessment model is constructed based on the virtual reality environment.

Virtual Books and Libraries

By adding an AR scan code below a knowledge point or a picture illustrating a knowledge point, students can scan AR scan codes through their iPads or mobile phones, a 3D target object can appear, and students can zoom in, zoom out, delete and other operations on this 3D model to deepen their understanding of knowledge. For example, a biology class needs to explain a flower’s structure. The 2D graphics do not allow students to understand the structure of the flower, which may also lead to an incorrect understanding of the structure of the flower, while through the 3D flower structure, students can correctly understand the flower’s structure through operations rotating and zooming.
Using VR technology to build a virtual library can let students immerse themselves in reading books. However, the virtual library has not been realized in technology, and there are many technical difficulties, such as finding books in the library and converting the existing books into VR form.

Virtual Gymnasium

Virtual gymnasiums are very helpful for students in agro-pastoralism areas with higher altitudes, which have harsh climates with frequent snowfall. In this extreme climate, students are bound to suffer physical discomfort when playing sports outdoors, but exercise is even more important to improve their health. That is why it is necessary to create a virtual gymnasium. Of course, they must perform all these sports under safety measures, which the Omini walking system can protect.

Vocational and Technical Education

Education in agro-pastoralism areas is relatively underdeveloped. To solve the local employment problem in agro-pastoralism areas, virtual vocational and technical training, such as vehicle maintenance, circuit maintenance, and other technical training, can promote the speed of students’ technical proficiency in a training base and practice site. Figure 13 shows the virtual training base for students to conduct technical training.

Practice Application

We use holographic equipment and VR equipment to create a K12 holographic wisdom classroom for the First Ethnic Middle School in Zeku of Qinghai, including a holographic biology virtual experiment system, holographic chemistry virtual experiment system, holographic physics virtual experiment system, curriculum resources using advanced virtual reality technology and artificial intelligence technology. We aim to create an innovative laboratory comprising a multi-person holographic interactive system, desktop holographic interactive all-in-one machine, and rich teaching content, and create an experimental environment with an acute sense of user immersion. The rich, interactive, interesting learning environment can enhance students’ interest and motivation while stimulating their creativity and imagination.

CONCLUSION

This paper first collates and summarizes virtual reality technology to solve the problems of the shortage of teaching resources and the backward development of teaching technology that commonly

Figure 13. Virtual training base
exists in agro-pastoralism areas. Second, this paper outlines the current situation of the development of virtual reality in education. Finally, this paper proposes a virtual reality teaching technology and application platform based on the current situation and teaching mode of education. However, there are still some problems in the teaching application in agro-pastoralism areas, such as improving teachers’ information technology ability, integrating VR technology into traditional teaching, and guiding students’ active learning knowledge. These problems need further research. Moreover, in making VR courseware aligned with the syllabus, some experiments, such as physical experiments, cannot be matched with a 3D visualization. Immersive operation experiments can make students more proficient in experimental procedures, but the helmet is too heavy, which is a burden for primary and secondary students. Virtual reality will significantly influence the industry in the future, but we must not overlook its importance in the educational sector.

ACKNOWLEDGMENT

This research was supported by the National Key R&D Program of China (No. 2020YFC1523300), and the Youth Program of Natural Science Foundation of Qinghai Province (No. 2021-ZJ-946Q). Zhonglin Ye and Yanlin Yang have contributed equally to this work and should be regarded as co-first authors.
REFERENCES


Zhonglin Ye is currently an Associate Professor with the School of Computer Science, Qinghai Normal University. He is also currently a member of the China Computer Federation. He has received research grants from National Natural Science Foundation of China and Natural Science Foundation of Qinghai Province. He is the member of the National Key Research and Development Program of China and the State Key Laboratory of Tibetan Intelligent Information Processing and Application. He was nominated twice for the best academic paper at the 6th and 7th CCF Bigdata conferences hosted by the China Computer Federation. His main research interests include data mining, knowledge discovery, link prediction, network representation learning, and machine learning.

Yanlin Yang is currently a Ph.D. candidate with the school of Computer Science, Qinghai Normal University. Her main research interests include complex network, link prediction, and network representation.

Lei Meng is currently a Ph.D. candidate with the School of Computer Science, Qinghai Normal University. His main research interests include complex networks, hypergraph theory, and graph neural networks.

Gege Li is currently an M.D. candidate with the School of Computer Science, Qinghai Normal University. Her main research interests include complex network, public opinions Analysis, emotion recognition, graph neural network, and machine learning.

Zhaoyang Wang is currently a Ph.D. candidate with the School of Computer Science, Qinghai Normal University. Her main research interests include complex network, Composite network, Hypernetwork research and mathematical modeling.

Haixing Zhao is currently a Professor with the School of Computer Science, Qinghai Normal University. He is the leader of the National Key Research and Development Program of China and the director of the State Key Laboratory of Tibetan Intelligent Information Processing and Application. His main research interests include complex networks, semantic networks and machine translation, hypergraph theory and database, and network reliability.