The reform of modern education during the COVID-19 pandemic

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Abstract. Great changes have taken place in modern education methods under the influence of the COVID-19 pandemic. Information science technology has broken through the time and space limits of education, as well as the boundary between physical and virtual objects in learning, and has converted the process of learning from passive to active. These characteristics just meet the needs of education under the challenges of the COVID-19 pandemic. Therefore, the new education mode which integrates information science technology has been developing rapidly during this period of time. This paper summarizes how the development of modern information science, especially network technology, multimedia technology and virtual reality technology, has influenced modern education. Meanwhile, our efforts and work in regard with digital museum will be introduced in this article.

1. Introduction

The outbreak of COVID-19 at the end of 2019 has not only brought inconvenience to people's daily life, but has also posed a severe challenge to education. At the very beginning of the COVID-19 pandemic, the Ministry of Education has put forward a request that the schools may be closed, but learning must not stop. And they announced on January 29th that a national cyber cloud classroom was scheduled to open on February 17. Hence, primary schools, secondary schools, colleges and universities started to teach online one after another. With the development of information science technology, especially the network technology, multimedia technology and virtual reality technology, the challenges caused by the pandemic may be an opportunity to promote the comprehensive informatization of education in some way.

At present, information technology is developing rapidly, especially new technologies such as communication, network, multimedia and virtual reality technology. On account of the need of information technology in education during the COVID-19 pandemic, the education mode is experiencing a great change. Compared with the traditional classroom education, the most important feature of the new education mode integrated with information science technology is that it breaks through the limitation of time and space, and no longer requires teachers and students to teach and learn face to face. Besides, the adoption of some new technologies can break the boundary between physical objects and virtual objects. Students can immerse themselves in the technology-constructed realistic scenario to learn. Moreover, learning is no longer a passive process. With the help of new information technology, students can determine the learning content, arrange the learning progress flexibly according to their actual situation. Next, the article will elaborate the influence that information science technology has had on modern education from three aspects, namely network technology, multimedia technology and virtual reality technology. The specific work we have done in the construction of Guyuan digital museum will be introduced as well.

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2. Education Enters the Era of Internet and Multimedia

In April 2020, the 45th statistical report on the development of China's Internet was released by China Internet Network Information Center in Beijing. By March 2020, China's Internet users had reached 904 million, with a penetration rate of 64.5%. There were a total of 75.08 million newly-increased Internet users throughout the year, with an increase rate of 4.9%. The number of mobile Internet users in China has reached 897 million, accounting for 99.3% of the total Internet users.\(^1\) With more and more people using internet and multi-media, modern education will inevitably experience changes.

By March 2020, the number of online education users in China had reached 423 million, with an increase of 222 million from the end of 2018. And the online education users account for 46.8% of the total Internet users. Under the influence of the COVID-19 outbreak, primary schools, secondary schools, colleges and universities all started to try teaching online, which led to the rapid growth of online education users, and promoted education into the era of network and multimedia.

According to some people's opinion, the development of educational technology firstly experienced the following three stages, from the visual education movement period (1918-1928), to the audio-visual education movement period (1918-1942), and then to audio-visual media period (1960s). And then in the late 1980s, countries around the world began to attach great importance to the development of education in the information age, and invested a lot of money in computer education research and application. The Ministry of Education, Culture, Sports, Science and Technology (MEXT) of Japan invested 2 billion yen every year to support the development of computer education. More than one third of the teachers in American middle schools once used computers in their teaching, while nearly one fifth of teachers often use computers during the teaching process, and the contents of the application of computer had been gradually infiltrated into the teaching of various subjects. Since the 1990s, the application of computer in education has entered a comprehensive, networked and intelligent development stage. Many new high technologies enter the field of education rapidly, among which the vital technologies are network technology and multimedia technology. Everyone in the education field pays more and more attention to long-distance education and the application of multimedia. Network and multimedia technology are gradually being applying to education synthetically.

Computer-aided education had experienced the development from the realization of program teaching (1970s) to the construction of Intelligent CAI system (1980s) before. Now, the application of multimedia and Internet in teaching will open up a new educational situation. According to the statistics, in the United States, the number of people who learn via the Internet is growing at a rate of more than 300% every year. By 1999, more than 70 million people had obtained knowledge, working skills through e-learning, and more than 60% of enterprises had ever carried out training or continuing education for staff by the way of e-learning in the United States. The Internet not only makes autonomous learning a reality, but also makes it fashionable.

The traditional classroom teaching is teacher-centered and duck-feeding teaching, which greatly limits the learner's autonomy. However, the emergence of the Internet has changed this situation. On the one hand, the Internet connects schools, research institutes, libraries and other information resources all over the world together to form a massive repository of resources. On the other hand, the Internet can gather the teaching resources of excellent teachers from all over the world together, and anyone can access it through the network at any place, which forms a many-to-many teaching mode. In this case, learners can choose when to learn and what to learn much more freely, thus autonomous learning becomes inevitable.

3. The Development of Information Science Brings Virtual Reality Technology

Qinping Zhao, academician of Chinese Academy of Engineering and director of the State Key Laboratory of Virtual Reality Technology and System, said at the first council meeting of “China Virtual Reality and Visualization Technology Innovation & Strategic Alliance” that, 2016 will become the first year of virtual

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\(^1\) China Internet Network Information Center. (2020) The 45th China Statistical Report on Internet Development. http://www.cac.gov.cn/2020-04/27/c_1589535470378587.htm.
Virtual reality technology in China². Virtual reality technology (VR) is a kind of technology that uses three-dimensional graphics generation, multi-sensor interaction, multimedia, artificial intelligence, human-computer interface, high-resolution display and other high-tech technologies to comprehensively simulate the real world. Education is an important driving force for the progress and development of human society. Introducing virtual reality technology into education to develop new teaching methods will play an significant role in helping students master various skills more efficiently and actively.

Virtual reality technology came into being in the United States in the 1960s. In recent 10 years, with the rapid development of computer information technology, it has been widely used in more and more fields. The emergence of virtual reality technology even makes three-dimensional scene appear in the two-dimensional world of the Internet.

Virtual reality technology had been used in teaching field very early in some countries in Europe and America because it can create situations similar to the real society to satisfy the situational teaching and natural interaction needs of new education pattern. In 1985, the United States National Library of Medicine began to study the digitalization of the pictures of human anatomy. Subsequently, the University of Hanover in Germany established a virtual automation laboratory. The University of Padova in Italy established a remote virtual education laboratory. The National University of Singapore carried out a remote oscilloscope experiment and a pressure vessel experiment. And in 1995, the first "virtual anatomy" experiment appeared on the Internet. As we can see, the application of virtual reality in education had received much attention in some countries in Europe and America.

There is still a certain gap in the development and application of virtual reality technology between China and developed countries, but this gap has attracted the attention of relevant departments and scientists. They have made plans to carry out virtual reality technology and related technology research one after another according to their actual situation. Tsinghua University has built an automobile engine testing system via virtual instrument technology. The Engineering Testing Laboratory of Mechanical Engineering College Huazhong University of Science and Technology has publicly displayed their achievement of their virtual laboratory on the Internet for the use of long-distance education. A number of other universities, such as Fudan University, Shanghai Jiao Tong University and Guangzhou Jinan University have also developed a number of new virtual instrument systems for teaching and scientific research. However, as we can see from above, the application of virtual reality in China's education is still limited to the research-oriented and exploratory teaching in Colleges and universities, while there is a long way to go to spread the technology among ordinary colleges and universities, along with secondary and primary schools.

The teaching scenario created through virtual reality technology is quite different from that in the past. With this technology, things that don't exist at the moment can appear in front of us magically. For example, some students in the suburbs of Newcastle, England, have designed several virtual cities using virtual reality technology. In these virtual cities, students seem to be walking on the streets of Germany, counting virtual francs and shopping in the market. They have also successfully built a virtual factory which is used for health and safety education. At the same time, educators are also exploring the potential of virtual reality. Virtual reality technology provides a brand-new way and scene for learning. In 1995, a world-famous “Virtual Frog Dissection” experiment appeared on the Internet. With regard to this experiment, learners had a heated discussion on the network and tried dissecting the frog by themselves on the computer. After that, Peking University launched the first archaeological virtual simulation experimental teaching platform in China. Learners can "visit" a primitive tomb and carry out "on-site" excavation via this platform. Virtual reality technology makes education break through the limitations of traditional textbooks. It enables learners to acquire knowledge through active exploration in specific scenes, so as to improve learners' learning efficiency, expand their horizons, and cultivate their innovative

² Xiao, G.H., Zhou, Y. (2016) Implementing the Strategy of Science and Technology Innovation Platform to Welcome the First Year of Virtual Reality of 2016 — Sidelights of China Virtual Reality and Visualization Industry Technology Innovation Strategic Alliance Council. Science & Technology Industry of China, 2: 44–46
consciousness and practical ability. Especially for some dangerous or costly experiments, through virtual reality technology, learners are able to obtain real feelings and results at lower cost and risk.

To promote the progress of modern civilization, we need to improve the skills and qualities of all mankind, and as such, advanced means of education are necessary. By utilizing virtual reality technology, we can construct various virtual environments used in teaching, so that students can participate in the "real scene", get in touch with a lot of perceptual materials, from which they may naturally find problems. At this time, we can let the students to figure out preliminary idea to solve the problem according to their past experience and knowledge, or from similar things. Then they can analyze and solve practical problems according to their ideas to verify the correctness of their ideas in practice. Through this way, students are able to obtain real and complete knowledge. Teachers’ role is to give proper guidance and inspiration only when necessary.

4. Construction of Guyuan Digital Museum

In the application of virtual reality technology in teaching, one of the difficulties is to make digital virtual materials. Digital museum is one kind of the digital virtual materials. Digital museum is built in the digital space, and the biggest difference between it and other kinds of museums is that the form of its collection is digital.

We participated in the construction of Guyuan digital museum. Guyuan is on the Silk Road. The Silk Road is a vital bridge connecting the east and the west in ancient times. It has played a very important role in the communication and integration among various nations of China and the cultural exchanges between the East and the West. Guyuan, as an important node of the Silk Road, has played its due role in keeping the Silk Road clear and safe. Meanwhile, rich Silk Road cultural heritage has been well preserved in Guyuan. As a significant application of virtual reality technology and digital technology in modern social education and cultural inheritance, the virtual display and the digitization of Guyuan culture is just the digitization and virtualization of Guyuan Silk Road cultural heritage itself.

The digital platform of Guyuan museum is composed of three basic platforms, namely digital resource acquisition and implantation control platform, human-computer interaction experience platform and virtual digital content display platform. Three platforms complement each other to complete the resource processing, human-computer interaction and virtual scene display tasks.

In the digitalization process of Guyuan Museum, we adopted the scheme of all-round culture relics shooting. All-round culture relics shooting refers to using mature shooting means and shooting system to shoot the cultural relics from various angles. After the collection of the pictures, we used the panoramic production software to synthesize a 360 degree, omni-directional and interactive three-dimensional interactive scene for display.

All the scenes are collected in a professional studio. This method is more suitable for scenes collection of cultural relics which are less than 100 kg each, not very reflective, not transparent, easy to move and arrange. The studio covers an area of about 9 to 15 square meters. The advantage of this method is its high flexibility. In the professional studio, we can adjust the lighting and background according to the characteristics of different cultural relics.

At present, these digital achievements are preserved in Ningxia Normal College and can be used by the teachers and students.

5. Conclusion

The development of information science technology, especially network technology, multimedia technology and virtual reality technology has had a great impact on modern education. In particular, the COVID-19 pandemic emerged last year and is still prevailing now in many places, which has caused much misery for people all over the world. However, there is no denying that, to some extent, the pandemic has played a positive role in speeding up the popularization of the application of information technology in education.
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