Proceedings of the 5th International Conference on Computing and Data Science
DOI: 10.54254/2755-2721/16/20230897

Virtual reality technology in the field of education

Ruohan Gao

College of Computer Science and Cyber Security Oxford Brookes College, Chengdu University of Technology, Chengdu, 610000, China

gaoruohan@stu.cdut.edu.cn

Abstract. Virtual Reality (VR), the technology has been around for years, are now developing rapidly since 2010s, VR game facilities can often be seen in shopping malls and the conception. Metaverse are now mentioned and are put into practise. Moreover, from word-of-mouth through books, blackboards, and ultimately multimedia, the educational approach has consistently developed. But in the process of practice, it has been proved that conventional education is predicated on teacher-cantered instruction, and students frequently wind up being passive knowledge carriers who are unable to fully acquire, interpret, and apply knowledge. In this paper, the new form of education which combined with VR technology will be discussed, and the analysis of positive effect of applying VR on education will be find out. The education of VR is divided into three parts to discuss, school safety education, subject education and vocational education. This paper will conduct a targeted analysis based on the respective attributes of these three types of education. With the knowledge of VR on education, people can carry out more in-depth cooperation and development on future VR and education based on these advantages.

Keywords: VR, education, immersive, practise, simulate.

1. Introduction

Virtual Reality (VR), the technology that can bring people a virtual sensory experience and make people feel immersive as if they are actually in the virtual world they perceive [1]. In the 2010s, due to the progression of technology like graphics processing technology and motion capture technology, VR technology has entered a period of rapid development, especially in 2016, the entire VR industry chain is developing strongly, a new generation of more powerful products has been launched in chips, engines, development tools, video editing and sound effects [2]. And now in the 2020s VR is keep on progressing and the concept of the metaverse has also been proposed which highlights VR devices as well as the ecosystem. As the technology enhanced in many fields, for example, the improvement of chip integration, material technology, industrial chain integrity etc. Virtual reality (VR), the technology combines several technologies, including computer, electronic information, simulation, dynamic environment modelling, real-time three-dimensional graphics production, stereoscopic display and sensor, is now becoming more and more available, VR devices are now become relatively cheaper than before and can provide users with a better experience meanwhile integrated [3]. Even though for the average consumer, VR hardware is still expensive, VR is indeed affordable for organizations such as schools and businesses. Meanwhile in traditional ways of education, students are often taught verbally by teacher and textbooks, when Learning is a collaborative process. People cannot study in a socially

DOI: 10.54254/2755-2721/16/20230897

isolated atmosphere. Processing abstract and multidimensional information is becoming a skill that is valued more and more [4]. However, with the VR technology introduced in schools, these problems can be alleviated.

This research will discuss the application of Virtual Reality (VR) technology in the field of education, and the focus will be on the combination of VR technology and education arranging from safety education, subject education to vocational skills training, analysis the influence of VR technology in this area of education. Moreover, the real case of VR applied in education will be mentioned below, through anatomizing these cases, impact of the application can be present in a clear and reasonable way.

2. The Application of VR in school

In traditional education in school, students are taught by using their text book, teachers' handwriting on the blackboard, thus makes them difficult to get practice opportunities and would be somehow boring. However, with the development of VR technology, VR are becoming more accessible, meanwhile increasing number of schools are introducing VR technology to schools in many areas so that let their education become more vivid and have higher efficiency.

2.1. VR and school safety education

Nowadays safety education is common in schools and in order to make the students feel more real about the disaster, many schools in China are now bringing VR technology to the school safety education. A new safety education hall built in ShenZhen Senior High School have already introduced the VR technology, with the help of VR equipment, students can experience the disaster scene close to the real in which case can create a sense of urgency for students without letting students actually go through the disaster personally, thus makes it possible to enhance awareness of safety and emergency avoidance, meanwhile guarantee safety of students' lives and property. The simulated driving experience in the hall (Figure 1) are one of the safety experience projects using VR technology, with the VR headset that would generate separate images and will be will be scaled and adjusted by optical elements for each of the human eyes, people can see the virtual road and car cab, the device is also equipped with a platform that allows people to do some simple drive action and gives the driver feedback of driving such as the crash of cars simultaneously. Before the introduction of VR technology, most safety education would limit to theoretical education or just hold simple exercises which there is no danger happen at all, so that when the real one comes, most students would feel panic for lack of experience and may forget what they've taught to handle problems thus put themselves in dangerous. Whereas, after integrating VR technology which can simulate three-dimensional images generated by computer electronic equipment and combine the characteristics of human vision, hearing, and touch. For example, users of VR technology can immerse themselves in the virtual environment using corresponding hardware equipment with safety education. The process of education would provide students the sense of facing the real danger and let them experience the panic mood and learn how to calm down when it is emergency as if students have actually been through a danger [5].

Figure 1. Teacher of ShenZhen Senior High School experience the simulated driving with VR equipment.

DOI: 10.54254/2755-2721/16/20230897

Moreover, in conventional safety education, students barely have interest in it and most of them thus treat them Perfunctorily, they barely follow the instruction and hardly remember the measure of dealing with the danger that they would probably face in the future, for many students the safety education is nothing but a burden in their study since most of them are already tired of studies. But the introduction of VR experience can turn the originally boring safety education into an attractive one which will lead to a higher concentration of students who attend the education.

Firstly, though VR technology are widely used in many fields, many people now have not experienced the VR device which will make them feel novel.

Secondly, the VR device used in safety education provide a game-like experience which would attract students in a great deal, normally students would immerse in the process of playing game, with such high concentration, students can probably gain more experience of handle problems while facing danger.

To sum up, the introduction of VR technology in safety education makes it become better. First of all, it will improve the realism of disaster, experiencing the real sense of dangerous, not only will it improve students' awareness of danger and be aware of danger other than being contemptuous about it, but also it can train students' psychological endurance while facing the real danger and handle it calmly. Meanwhile it will lift students' spirits of engaging the safety education, thus leads to a higher concentration than the traditional one. Hopefully, in the future, people can combine more and more projects of safety education with VR technology and enhance the devices' sense of experience.

2.2. VR and school subject education

As it known to all, subject education is the most important part of school education. For the purpose of raising students' interest of learning and strengthen students' understanding of knowledge, making abstract knowledge concrete, VR technology are combined with tradition teaching style in many schools. In Qingdao Experimental High School, the school brings VR technology to biology classes (Figure 2), by using the VR devices like headset, The two-dimensional images in the text book become three-dimensional and presented in front of students' eyes and Students can also use VR equipment to perform base pairing, which cannot be achieved by only showing 3D modelling in power point. Given that biology classes are mostly about the study of the microscopic world such as the cell level or even the molecular level that we cannot see in our normal life, and even with an optical microscope we can only see two-dimensional images of cells. But with the help of VR technology, students can have full-angle observation of microscopic things such as cells and observe the activities of microscopic things meanwhile influence these activities themselves, for example, they can control environmental variables in a virtual world to observe changes in cells.

Figure 2. Student of Qingdao Experimental High School explore the micro world with VR equipment.

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From these practises of VR on education, benefits can be easily found out. For one thing, most of the knowledge in textbooks is abstract, many of them are the natural laws that cannot be observed in daily life, which would make students hard to make sense of. Whereas, VR works on the premise of creating a virtual world — real or imagined — and allows users not only see it but also interact with it. It can let students be in the world that is feasible to observe these rules like what we have mentioned before, participating in the pairing process of alkali base with VR devices [6]. For learners to gain smart abilities, Limniou and Roberts et al. created a virtual reality system that mimics the environment and explains the chemical interactions that lead to acid rain at the molecular level. According to the study, students performed much better on pertinent chemical questions when studying in a 3D environment than they did in a 2D one, and they also gave the 3D environment higher marks [7].

For another, in many classes, it would be in the model that the teacher imparts knowledge and the students are only responsible for receiving it, which is similar to the simplex communication. As a result of which the classes lack interaction and students lack a sense of participation, which also leads to a low willing of attending classes. It is true that asking students questions can actually improve the participation of students, but it doesn't help to improve students' interest and even makes it worse. Nonetheless with VR technology, knowledge will be present vividly in a virtual world where students have greater autonomy, in which case let students change from passive acceptance of knowledge to active exploration of knowledge. At the same time, novel virtual perspective and game-like experience provided by the VR devices will raise students' interest that can hardly gain from traditional class. We can often find students distracted in class, playing with their robber or talking with classmates, which is response to the boring class that can hardly attract people. Whereas, as long as the tradition ways of teaching turn into a game-like one which can be much more absorbing, fewer students will be distracted in class.

In conclusion , by applying VR technology in subject education can fully reflect the imagination of VR mentioned by Burdea G and Philippe G oiffet, in which case, gives students the ability to envision the system's future as its operational status changes using cognitive processes like association, reasoning, and logical judgment in the virtual world based on the many pieces of information they have gathered and their own actions within the system, thus students can learn more about the fundamental motion mechanisms and regularity of complex systems [8]. So that deepen students' understanding of knowledge and grab students' attention.

2.3. VR and vocational education

Apart from school education, vocational education is also important. With the development of technology, professional worker equipped with knowledge that can adapt to technological developments is widely needed, which means the equality of vocational education needs to be enhanced simultaneously. In order to meet this requirement, VR technology can be introduced to vocational education, which provide a solution. In Shenzhen Polytechnic, VR technology has been introduced since 2019 (Figure 3). In Vocational education, many disciplines have a high-risk factor and are polluting, for example like chemical personnel training and Mechanical Engineering Staff Training, thus makes it hard for schools to organize hands-on learning, whereas hands-on learning is important in education without which students cannot scrutinize the knowledge they've learned and would forget in a short period of time.

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Figure 3. Students of Shenzhen Polytechnic in the virtual reality training room.

With VR devices, the experiment environment can be established virtually and students can receive real-time tactile and auditory feedback similar to the reality, allowing students to skills learned in class in a safe and pollution-free environment. Electric welding, a common course in vocational education, is dangerous to the operator, especially to the tiro like students new to welding for unskilled operation, can cause accidents, at worst may let people blind. To avoid this from happening, many vocational schools combine their weld-teaching with VR technology, students new to welding can use VR devices which have a head-set to simulate the welding process, meanwhile equipped with a handle as soldering pen (Figure 4.), giving students feelings of welding close to the real. So that students that lack of emergency response skills can weld without facing the accident of getting burned or something like machine failure.

Besides, vocational education is mainly oriented towards grassroots operations, such as production workshop workers. With the development of technology, the equipment operated is now become increasingly complicated and expensive. For instance, Automated Automobile Production Line would be hard for schools to have a real one for teaching so that vocational education would be confined to conceptual knowledge from books. For vocational education, the type of education that emphasizes practicality, this is obviously inappropriate.

However, we can combine VR with education, for example, railway transportation, the major that teaching people how to operate and manage railway transmit such as letting people learn how to operate track switch machines. Obviously, this is no way for school to build a railway transmit system equipped with tracks and trains, and it is also impossible to let freshman train at the railway sector regardless of safety, before the introduction of VR, schools mainly train students with model which can be easily damaged and can hardly simulate the real sense, luckily with VR devices, cab, console as well as compartment can be constructed in the virtual world making it possible for students to have hand-on practise and to apply conceptual knowledge to practical operations. The virtual training scene produced by VR technology can cause the learner to automatically interpret the virtual scene as the real scene, assisting the learner in producing the same response as the real scene, improving the learner's response mechanism, and enhancing the practical training experience. The quantity invested can improve learners' professional skills, solidify their recollection of previously taught information, and help them internalize it more deeply [9].

All in all, in vocational education, traditional practical teaching professional training equipment has a complex structure, high unit price, serious equipment loss, and abnormal equipment loss, and some professional practice operations are still dangerous [10]. Nonetheless integrate VR technology with vocational education can bring lots of benefits to vocational education, including avoid students from getting hurt by dangerous actions, as a result improve the safety of education. Moreover, it can also deal with the issue of lacking equipment to hold hand-on practise by creating a virtual one.

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Figure 4. Students using VR welding equipment.

3. Conclusion

Above all, this essay discussed about the application of Virtual Reality (VR) technology in the field of education, and the range of education was divided into three parts for a further detection ranging from School Safety Education, School Subject Education to Vocational education. According to the discussion, the integration of VR and education can be beneficial, since the VR devices can construct virtual scene close to the real and give students a sense of authenticity, it can bring a sense of tension to students when experiencing the safety education, instantiate a conceptual concept letting students have a better understanding and deal with the lack of complicated devices in vocational education simultaneously. Also experiencing VR devices can bring people a game-like feeling, as a result can intrigue students so that can raise students' concentration, Moreover, its Virtuality enable people to simulate some dangerous environment like polluting experiment.

Hopefully in the future, VR technology can be introduced to more and more fields of education, at the same time, the precision as well as reality of VR can move to a higher step meanwhile reduce manufacturing cost making it more affordable.

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