Research and Application of VR in Training and Learning

Kaidong Wang *
Gilmour Academy Gates Mills, USA
* Corresponding Author Email: kaidong.wang@gilmour.org

Abstract. With the rapid development of VR technology in the past two years, VR education has broken the rigidity and single way of traditional teaching. This paper discusses and analyzes three aspects of VR in the field of training and learning. specifically, the convenience and efficiency of VR in the classroom; an overview of the savings and simplicity of VR skills learning. And a comparative analysis of innovation and breakthroughs in the field of VR art learning. So far, VR technology is still only in the newly developed stage, and there are various problems waiting to be solved, such as expensive, unfriendly to students who wear glasses, etc. But despite certain shortcomings, VR technology has great application prospects in the future. These skills training and learning based on VR are elaborated and analyzed. Finally, the paper summarizes and looks forward to the full text.

Keywords: VR, training skill, educational learning, VR art.

1. Introduction

According to Moore's Law, technology is now evolving at an incredible rate. The latest chips can become obsolete in just a few years, and our daily lives are changing rapidly. Many students are tired of the classic teaching methods [1]. Modern Virtual Reality (VR) technology holds students' attention the most. Students are beginning to use tablets and computers in the classroom to learn more effectively, and technology directly interprets the style of instruction in the classroom. The future of education technology is exciting, especially when you consider the advances in specific technologies such as VR, stands out by immersing the learner in the entire learning process and eliminating the physical distance between people. the point of VR is to transform educational content by creating a virtual world. Using VR and augmented reality as immersive learning tools, people can travel around the world, explore the impossible, delve into complex concepts, and experience learning directly in the palm of their hands. At the same time, VR has great future prospects to create many novel ways of teaching and learning, reducing unnecessary loss of resources and danger through simulated reality as it becomes a safe, economical and efficient way of teaching and learning [2].

In this article, the research and application of VR in skill learning and training will be introduced. More specifically, it will discuss VR in classroom learning, skill education, and art learning and other educational fields for analysis and discussion.

2. VR and Classroom Learning

According to Moore's Law, the technologies developed at an incredible rate nowadays. The newest chip can be outdated in only a couple of years and our daily life changes rapidly. Students started to use tablets and computers in class to study much more efficiently and technologies directly interpret the style of teaching in classes. Even though the Covid-19 pandemic has trapped countless people in their homes in a sudden and powerful way, teachers can still teach from home and communicate with students face-to-face via Zoom or Google Classroom (Fig.1). But of course, the online classes are not as effective as a real in-person class because the attention of students can be easily distracted from classes into the extensive cyber world. Also, students can’t pay all the attention in class because most of them stay at home and they have a feeling that they are truly in classes since they might complain with their family members or friends sometimes in classes [1].

Figure 1. VR based classroom learning

In this case, virtual reality, VR in short, stands out and immerses learners in the entire learning process, which eliminates the physical distance between people. There would be no difference in staying home with VR devices and presents in person in classes. Not only that, liking computers helps students to get way more resources to understand a specific context, VR can bring students into the three dimensional world which is much easier for students to understand than placing those 3D staff into a simple and flat paper [3]. For example, students can not only watch a documentary about dinosaurs, but also experience all aspects of the environment in which dinosaurs lived in the Jurassic period, and even what it was like to be a dinosaur itself.

Such a thing is impossible to accomplish through the traditional education method. Meanwhile, when they encounter problems they do not understand, students can communicate through language until they deepen their understanding, completing the teaching process at the same time and in the same space as the teacher. However, due to the subjective nature of language and writing, there is often a discrepancy between what students understand and what the teacher is teaching during the communication process. Teachers need to demonstrate key elements of learning or use visual aids to supplement instruction so that students can understand and remember (Fig.2). This is especially important for skill-based instruction, such as Chinese calligraphy.

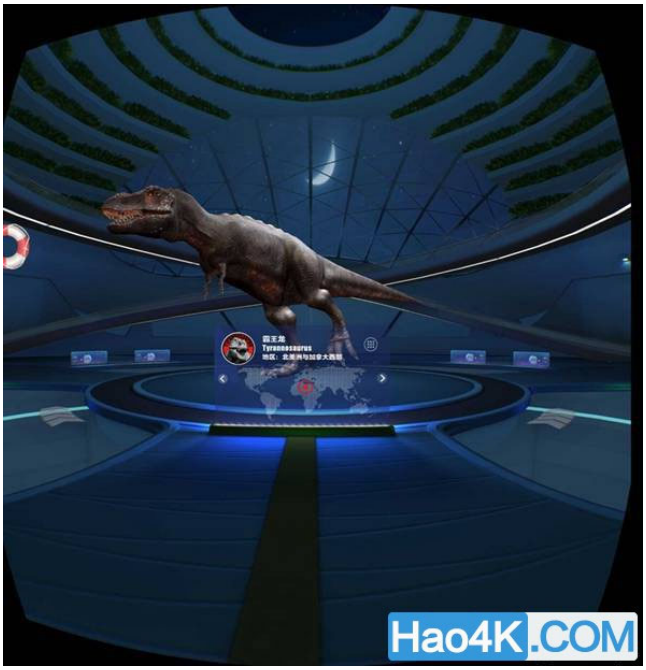

Figure 2. VR 3D classroom effect

At the same time, the innovation and convenience brought by advanced technology can make students learn more efficiently. Our fast-paced environment is constantly changing and technology

provides instant gratification. Because of this dynamic, students will be able to focus more easily and even those children with ADHD will be able to learn a lot more successfully in a VR world. Moreover, surveys also show that the average student remembers about 30 percent of what they hear and 20 percent of what they see. But when they experience something in person, their memory skyrockets to 90 percent [4-5]. Furthermore, Students often need to demonstrate their proficiency and express their understanding face-to-face, and students need teacher guidance and constructive feedback as they practice. In traditional education, text, images, and video can help students enhance their understanding, but for manipulative instruction, abstract symbols (text, images, and video) do not provide visual aids.

The environment created and the research conducted confirm that VR technology can also be used for education in demanding areas such as designing and testing digital circuits for engineers and specialists. Of course, more work needs to be done to expand the use of VR in this curriculum. Thus, based on the results obtained, VR systems should complement computer software-based education. This is similar to training programs in industry: we can see some new solutions in traditional training courses, based on long practical experience, and we consider them as a useful extension that can be adapted to different external and internal conditions. It is worth noting that a large number of students find that VR systems help to learn better, but they also attend regular courses. Therefore, for the time being, they cannot completely replace regular classrooms [6].

So far, VR technology is still only in the newly developed stage, and there are various problems waiting to be solved, such as expensive, unfriendly to students who wear glasses, etc. But despite certain shortcomings, VR technology has great application prospects in the future. It can truly take students into the world of the Internet and make remote learning courses efficient.

3. VR and skill learning

VR, once an unattainable word for people, is now coming into people's daily lives step by step. Since this technology is using the cyber world to rebuild the reality we live in, all the things and facts in our live can be put in the virtual world which means VR can be used on everything in our life, including driving, cooking, and nursing (Fig.3).

Figure 3. VR skill training

Putting more detail, the automotive industry, one of the largest investors in VR technology, is expected to reach approximately $673 billion by 2025. While the vast majority of these funds are spent on self-driving research and development, VR can also help people learn to drive until truly perfect autonomous driving comes out [7]. VR as a tool can be more effective in familiarizing people with the operation, test center, road conditions, and various other situations (Fig.4). At the same time, learning to drive through VR can significantly reduce the chances of traffic accidents while learning.

Figure 4. The application of VR in automotive simulation experience

The portability and fault tolerance of VR makes it a good application for learning to cook. The existence of VR equipment allows people to practice preparing various dishes without relying on gas, natural gas, various cooking utensils and ingredients in the kitchen. This approach not only reduces the waste of resources and achieves an environmentally friendly effect, but also reduces the time spent on cleaning up after a failed production, enabling efficient and easy learning. Meanwhile, since the cooking process is completed in the virtue world, there can be some buttons, directions and texts to help learners know what is the next step. The resulting muscle memory can be very helpful in helping them to complete each step when they are actually cooking. Furthermore, learning the way to cook by using the VR devices can avoid getting into some unnecessary trouble, such as hurting yourself by using a knife, boiled water or oil, triggering the fire alarm from the steam while cooking, and so on (Fig.5). As a result, using VR to learn cooking ability will be popular in the future and would help more people to know how to cook.

Figure 5. VR in Chef learning experience

The most promising application of VR in the medical field is medical training. Virtual reality technology is currently well applied in the direction of internal medicine, surgery, respiratory intensive care, and cardiac surgery [8-9]. But since virtual reality technology is based on the immersion and interactive behavior of people's consciousness to achieve effects and feedback. So, for the application of virtual reality technology, the following diseases need to be excluded, patients with mental confusion or delirium, neurological diseases, history of brain injury, patients with infectious diseases, severe mental and cognitive disorders, mental retardation, dual visual-auditory impairment and contraindications to activities. The means of application of virtual reality technology in the field of medical care by some VR medical devices (Fig.6).

Figure 6. VR medical device

Fully immersive 3D surgical simulations can help train young doctors to watch and learn surgery in the operator's field of view, maximizing the proximity to actual surgical scenarios, enhancing learning, and providing greater assistance in learning more complex surgeries. The use of VR content allows young people to perform surgical trials in a virtual world, which is a significant resource saver, while being reproducible and making it easier for students to gain important medical experience [10].

In a recent randomized study conducted at UCLA, 20 participants were randomly divided into two groups, with one group using a VR surgical training platform for surgical training and the other group learning through traditional surgical learning methods. Their performance during the training was recorded and a surgeon rated the participating students based on time, instrumentation and five minutes of surgical proficiency. The results of the study found that the group using VR technology performed well in all categories of surgery, scoring 130% higher overall compared to traditional instruction, which is invaluable for surgeons to have more visibility during surgery. And back in 2017, the Royal London Hospital used VR technology to do the world's first 360VR brain aneurysm treatment [11]. And according to Dr. Axelrod, VR technology has been used to train students and educate patients since 2016, which includes students, doctors, and even patients. Some studies have also found that immersive VR technology can reduce user stress and help patients recover. For example, researchers at the University of Louisville have experimented with VR technology to treat anxiety and phobias, using some VR devices to record physical characteristics and consult with doctors based on individual physical conditions (Fig.7).

Figure 7. Medical skills training based on VR

In conclusion, VR steps in our lives gradually which led people into a completely different and efficient style of life. In the future VR technology in the application of life is bound to be easier. It also believes that VR technology has a better development space in the future, which is a very worthy thing to look forward to.

4. VR and Art Education

VR panoramic interactive systems give people an unprecedented browsing experience through 3D panoramic photography, restoring the real world to the Internet in a realistic way, so that people watching can be in the real world without leaving home (Fig.8). VR technology breaks the constraints of time and space, so that even customers or students who are far away from the other side of the ocean can accurately understand the information we want to deliver through VR in the first place, instead of needing to Instead of having to constantly explain the meaning to them on a flat sheet of paper [12]. To be more specific, VR can reduce the class gap in art learning, attract young painters to learn and exercise students' spatial imagination.

Figure 8. VR multi-dimensional display capability

VR technology will go some way to bridging the educational injustice divide, especially in art since a life of leisurely living for the rich produces the qualifications required of an artist better than the poor struggling in poverty. VR content, with its low marginal cost and long-distance delivery, could make even the remote poor feel like they are there for a learning experience that spans geography and time [13-14]. The children of the rich and powerful can travel thousands of miles to the Sistine Chapel to experience and study the Genesis frescoes for themselves, or they can invite the best experts to talk about them, but using VR technology, this experience can be replicated and disseminated indefinitely, giving the children of the poor the opportunity to experience the best second-hand experiences constructed by virtual technology (Fig.9).

Figure 9. VR artistic creation

The virtual experience teaching mode will also bring new teaching concepts, such as combining VR teaching with the addictive means of online games, which would make learning art concepts become a very simple and easy thing. For example, prompting students to master knowledge by fighting monsters and upgrading along the way. Instead of becoming bored with learning because of rote memorization of indoctrinated knowledge, children will be more motivated to face learning. VR

live streaming allows students from different geographical areas to listen to the lesson as if they were in the same classroom. The cross-temporal feature allows students to experience different identity roles and switch between different scenarios for learning, and they can turn around the globe in a day. By learning in this way, students are able to better grasp the nuances of brushstrokes and the use of color [15].

Last but not the least, since VR technology puts students into a 3D world instead of a flat paper, students can better exercise their spatial imagination in such a situation. Spatial imagination is to help us solve problems by observing a certain spatial geometry, such as a certain three-dimensional geometric diagram, analyzing and studying the relationship between elements such as points, lines, surfaces and angles, and then translating them into concrete mathematical language. Spatial imagination is to analyze and study the relationship between elements such as points, lines, surfaces and angles by observing certain spatial geometric figures, such as certain three-dimensional geometric diagrams, and then translate them into concrete mathematical language to help us solve problems [16-17]. Students practice various techniques for drawing three-dimensionality, such as depth of field, which can be felt in real 3D space, rather than constructing 3D space in 2D planes. This can go a long way in helping students better understand the relationship between the distance and size of objects, making it easier to show such a picture on the canvas (Fig.10).

Figure 10. An art exhibition based on VR

While VR is like a paintbrush to fine art, it is only a technical tool to achieve fine art expression. But it is interactive, immersive, and expands the expression of emotion. VR as an educational medium has the potential to improve teaching and learning compared to traditional media, but only if students are actively[engaged and have a high degree of autonomy, and interactivity is key to avoiding passive learning [11]. Some practical examples include giving students some freedom of action, allowing them to develop more knowledge in VR by triggering situations, or adding freshness to content by interacting with objects. So VR is still very promising in art education, and one day it will replace traditional art tools like digital boards.

5. Conclusion

This paper discusses three aspects of VR in skill learning, specifically analyzing the benefits of VR in the classroom; outlining the use of VR skills in learning and practice; and comparing and analyzing the problems that can be solved in the field of VR arts education. Meanwhile, the technology of VR has immeasurable prospects in the future. VR devices can bring a new experience and a very wide range of applications, but because the equipment is expensive and bulky and the high requirements of development have not been able to breakthrough for a long time.

The use of VR technology in learning and training has been able to help some students. However, this technology is not perfect and comprehensive. Expensive equipment, practicality, including all subjects, and applicability to different types of students are all areas that need improvement. We hope the best for this technology is a new way of learning that can stimulate students' interest and make them have a better engagement and learning experience. For VR in education, we see a future where VR can cover almost any subject, and students of all ages can use it to keep them interested in learning.

In the present day, just into 2023, VR devices are still far from universal. However, with the wide application of VR in education, medical treatment and art, VR is also gradually changing our future life.

References

[1] Dewey, J. Experience and education. In The educational forum, 1986, 50 (3), pp. 241 - 252.

[2] Lu, S. J., Liu, Y. C. "Integrating augmented reality technology to enhance children's learning in marine education". Environmental Education Research, 2015, 21 (4), pp. 525 - 541.

[3] Q. Xu. "The somatosensory educational games based on embodied cognition". University of East China, 2019.

[4] Habron, John, and Liesl Van der Merwe. "A conceptual study of spirituality in selected writings of Émile Jaques-Dalcroze. International" Journal of Music Education 35.2 2017, pp. 175 - 188.

[5] Cheng K H, Tang K Y, Tsai C C. "The mainstream and extension of contemporary virtual reality education research: Insights from a co-citation network analysis (2015–2020)", Educational technology research and development, 2022, 70 (1): pp. 169 - 184.

[6] Limniou M, oberts D, apadopoulos N. "Full immersive virtual environment CAVETM in chemistry education". Computers & Education, 2008, 51 (2), pp. 584 - 593.

[7] Chan J. C. P., Leung H., Tang J. K. T., et al. "A Virtual Reality Dance Training System Using Motion Capture Technology". IEEE Transactions on Learning Technologies, 2011, 4 (2), pp. 187 - 195.

[8] Krevelen Rick Van, Poelman Ronald. "A Survey of Augmented Reality Technologies", Applications and Limitations. Virtual Reality, 2010, 9 (1), pp.10 - 23.

[9] Su C., Han Z., "A review of application cases of augmented reality (AR) in teaching", China audio visual education, 2017, (3) pp. 1 - 9.

[10] Tao J, He Q, Na Z, et al. Exploring Virtual Display Design based on 3DSMAX and VR-Platform, IEEE International Conference on Computer-aided Industrial Design & Conceptual Design. IEEE, 2010, pp. 1 - 10.

[11] Ling Z, "Personalized healthcare museum exhibition system design based on VR and deep learning driven multimedia and multimodal sensing", Personal and Ubiquitous Computing, 2022, pp.198-207. \

[12] G. Weniger, M. Ruhleder, C. Lange, "Egocentric and allocentric memory as assessed by VR", Neuropsychologia. 49(3),2011, pp.518 – 27.

[13] S. Yoo, P. Gough, Judy Kay, Authors Info & Claims, Embedding a VR Game Studio in a Sedentary Workplace: Use, Experience and Exercise Benefits, CHI '20: Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems April 2020 pp. 1 – 14.

[14] N. Winkler, K. Röthke, N. Siegfried, A. Benlian, "Lose Yourself in VR: Exploring the Effects of VR on Individuals' Immersion" IEEE International Conference on Computer-aided Industrial Design & Conceptual Design. IEEE, 2012, pp. 12 - 20.

[15] C. Jennett, A.L. Cox, P. et al., "Measuring and defining the experience of immersion in games," International Journal of Human-Computer Studies, 2008, 66(9), pp. 641 – 661.

[16] O. Factory. What is the impact of VR VR on the education industry? 2020-11-11, http://www.heihuoshi.com/xw/hydt/696.html.

[17] VR Pinea. Will the next phase of the education industry be VR? 2019-04-23, http://www.vrpinea.com/article/index/id/248.html.