Proceedings of ICEIPI 2025 Symposium: Reimagining Society: AI's Role in Cultural Transformation and Learning Environments
DOI: 10.54254/2753-7048/2025.BO24191

Problems and Solutions Faced by Virtual Reality in Education

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Abstract: With the promotion of VR technology, Virtual Reality (VR) plays an essential role in various fields. However, in education, the role of VR is not particularly significant, which is inextricably linked to its problems. This article will discuss the problems of VR in education from the perspective of VR hardware and content, students, and educators. The study adopted the methods of literature analysis and case analysis, systematically sorted out the existing research results, and summarized the practical challenges faced by VR applications. The research data mainly came from academic journals, industry reports and related research literature. The results showed that in terms of hardware and content, high prices and inefficient teaching content are the main problems; from the perspective of students, physical discomfort and differences in teaching acceptance are the main problems; from the viewpoint of educators, how to use VR technology and how not to rely on VR technology is the main issue. Afterward, this article proposes strategies or solutions from the above aspects and looks forward to future development and application of VR in education.

Keywords: Virtual Reality, Immersive Learning, Physical Discomfort

1. Introduction

With the progress and development of the times, teaching methodologies are more comprehensive than traditional book-based teaching. New teaching methods emerge endlessly, and digital teaching is one of the most significant. Digital teaching and learning rely on digital tools (electronic devices, platforms, websites, and so on) to give lectures or do assignments; this method has become popular in recent years, especially during the global public health event, driven by the need for prevention and control, countries generally adopted measures to restrict the flow of people. Traditional offline teaching activities were therefore restricted, and the education field accelerated its shift to digital and distance teaching models. In addition, more and more teachers are integrating various digital teaching methods, such as slides and videos, into their teaching practices. The key reason teachers choose digital tools is that these tools " loosen the frames between formal and informal learning, making it possible to use tools more associated with leisure for educational purposes"[1]. Among these digital tools, Virtual Reality is a relatively special existence.

Virtual Reality (VR) is "an advanced human-computer interface that simulates a realistic environment" [2]. Due to the highly immersive characteristic of VR, people can experience different things in the VR world that they cannot experience in daily life. Therefore, plenty of companies have developed high-immersion software to help people experience different cultures. This also

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makes VR gradually become an educational tool for learning about culture and languages. Students can closely visit representative buildings in other countries without going abroad. Besides, students can practice their foreign language skills with a Nonplayer Character (NPC) in the software. Therefore, VR has become an educational tool adapted to schools and educational organizations. However, VR's academic performance has not made it a popular learning tool.

This paper discusses VR's problems in the educational area, including its hardware issues and challenges for educators and users. Then, it provides corresponding strategies and solutions to these problems and challenges. In the end, it identifies the role and future potential of VR's advantages in the field of education.

2. Current problems with virtual reality in education

As a digital device, VR's immersive experience allows it to be used in teaching. However, VR has not become popular in the education field or has become a mainstream educational tool. The essential reason is that VR has some problems with hardware at the current stage. Besides, VR brings a massive challenge to learners and educators.

The most prominent among these problems is the expensive VR hardware facilities. VR can bring people a highly immersive experience, inseparable from its excellent hardware performance. To ensure excellent hardware performance, VR companies usually invest extraordinary funds and human resources in developing new hardware. This also makes VR expensive compared to other electronic devices. According to Laurell, Sandström, Berthold, and Larsson's research, the only thing that stops people from having VR equipment is the price; they and "many others that are positive to it but have not yet bought it have not done so precisely due to the price"[3]. The price has caused individuals to have a weak desire to buy VR, which, to a certain extent, has prevented the spread and popularity of VR in different fields, including education.

Besides, VR's lack of function is also a weakness compared with portable and multifunctional smartphones. Firstly, high site requirements restrict VR's portability. Using VR equipment requires ample physical space to accommodate the user's movement in the virtual environment. The large room ensures that the space is large enough so that users can move freely without bumping into objects or walls. The floor should be flat to prevent users from falling while using VR, and floor material must also be considered to ensure users can walk on it safely. Most VR equipment requires power and a network supply, so the room must provide electricity and a network. In addition, some VR equipment must be linked to a high-performance computer/laptop; this not only makes requirements for the room but also increases the user's budget.

To sum up, VR has stringent requirements for scenes and environments, unlike smartphones that can be carried around, which makes it inconvenient as an electronic device. If schools want to use VR as a teaching tool on a large scale, besides the high price of VR and its supporting facilities, they must also provide classrooms dedicated to VR teaching. Such a classroom not only needs to have a wide area but also has corresponding power and network. This puts massive pressure on school land use and financial budgets. Secondly, VR's price and function do not match. From users' perspective, VR can help them be immersed in a feeling like they first come to the simulated reality, primarily by stimulating their vision and hearing" [4]. However, this is almost all the experiences or functions that VR can bring at present. Even if it lacks functions, excellent VR equipment still costs around US$1,300 to buy; at the same price, people can buy the latest Apple 15 Pro Max mobile phone. More importantly, because of mobile phones' multifunction, they have a higher usage rate than VR equipment. Therefore, from the perspective of practicality and cost-effectiveness, the necessity of VR is relatively low, which also significantly reduces people's desire to purchase VR equipment.

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3. Current challenge with virtual reality

"The application of Virtual Reality Technology in education has played a major role in promoting the education level and the sharing of educational resources" [5]. However, the application of VR in education also brings enormous challenges to users and educators.

For users, the physical discomfort caused by VR is the biggest challenge. VR "can be applied as a complement to three-dimensional modeling, leading to better communication in both professional training and professional practice" [6]. The 3D effect VR presents makes it highly immersive, which is one of the reasons why educators use VR as a teaching tool. However, VR's 3D effect also has negative effects. According to Malik, Khairuddin, et al.'s research, people experience discomfort while viewing movies and video content in 3D mode, including dizziness, headaches, nausea, etc. [7]. From a learning perspective, these physiological discomforts will lead to students' inattention and memory decline, thus affecting students' learning efficiency. In addition, these negative effects may lead to poor physical health of students in the short/long term. Therefore, for students, the learning effect provided by VR may not be as efficient as other learning tools. In addition to the discomfort brought by the 3D effect, heavy VR equipment also puts a load on the user's body. According to Brady, Dejaco, Lewis, McCreesh, and McVeigh's research, VR "headsets are heavy, which means that head and neck muscles can fatigue quickly during use" [8]. Therefore, VR equipment does not provide physical comfort, "since virtual reality equipment is heavy, meaning that spending a lot of time with it can be exhausting" [9]. For students, using VR for learning in class will be physically taxing. To a certain extent, using VR will cause students to focus on the discomfort caused by their shoulders and necks, thereby reducing concentration and learning efficiency. If students keep using VR day by day, it may even cause damage to their shoulders and necks. In addition to students, using VR in the classroom also brings huge challenges to educators.

For educators, the biggest problem is their lack of knowledge and familiarity with VR. As an emerging digital learning tool, "VR has been described as a 21st-century learning tool" [10]. It is difficult for educators, especially middle-aged and elderly educators, to familiarize themselves with and use such emerging educational tools as VR. Even if these educators are eager to use VR in their classrooms, they are faced with plenty of challenges, Meccawy pointed out that when teachers try to use VR technology, they often face uncertainties and challenges in many aspects, such as starting path, tool selection, platform subscription, time required and cost [11]. In addition, provided that this is a solo effort, as it often is, the task becomes overwhelming to the extent that it might result in dismissing their attempts to experiment with VR technologies. Suppose the teacher is only trying to use VR teaching in the early stages with a solo effort and cannot get support from school, parents and other parties. In that case, the task will become overwhelming to the extent that it might result in dismissing their attempts to experiment with XR technologies [11].

4. Solution and strategies for overcoming VR problems

Although VR currently has some problems and challenges, these problems and challenges can be solved with VR companies, schools, and educators. In addition, the solution to these problems also brings more possibilities for the future development of VR in education.

First, the company must improve production efficiency and improve the design of VR to reduce costs. VR companies should simplify the design, using fewer materials and cheaper components. For example, use plastic instead of metal frames or standardized electronic components. In addition, replacing metal parts with plastic parts can also reduce the weight of the VR.

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Yan, Chen, Xie, Song, and Liu's research "investigates the relationships between the weight of VR headsets and subjective discomfort and pressure load on the head," and their result implies that improving the physical comfort of VR headsets by reducing weight and designing one-piece headsets is a potential approach [12]. Therefore, replacing heavy metal with lighter plastic can reduce the overall weight of VR equipment and the load on the user's body, thus reducing the physical discomfort caused by the weight of VR.

For VR application developers, it is essential to solve the problem of physiological discomfort during VR teaching. According to Sannia, Thenara, Rivero, and Tan-Mullins, there are four aspects to be considered as plausible discomfort mitigation strategies in the context: movement speed, movement angle, graphics quality, design, lighting, and hardware selection [13]. They consider that VR developers should "investigate the impacts of altering the technical parameters of the VR features such as the movement speed and angle on the VR scene and user experience, and other potential ways of minimizing the dizziness effects" [13]. This can reduce the user's discomfort, ensure students' learning efficiency, and appropriately increase VR learning time. In addition, developers can design VR applications that fit into small spaces, including games, applications, and interactive scenes. These experiences can provide satisfying interaction and entertainment in a limited space while ensuring users can still fully enjoy VR in a small area.

For educators, VR may be new territory for many teachers, and it may take time to adapt and master the technology. Solutions to this challenge include providing specialized training and resources to help teachers master essential VR tools and applications. Schools and educational institutions can set up technical training programs to provide teachers with knowledge and skills in technological media. In addition, teachers can actively seek out online courses, training workshops, and community support to continuously improve their expertise in VR. For example, in medical education, "training may be accessed through liaising with vendors who supply trainers to educate staff through in-person sessions. Online video tutorials may also be a valuable learning tool to help staff gain competence with the VR software and hardware with the bonus of being repeatedly accessible to staff at a convenient time" [14]. Once educators are familiar with the equipment, they can introduce VR technology to stimulate students' interest in learning and improve learning efficiency.

5. Conclusion

This paper mainly discusses the problems and challenges faced by the application of virtual reality (VR) in the field of education, and conducts a systematic analysis from the perspectives of hardware and content, student experience, and educator use. Although VR has some problems and challenges in the field of education, such as high hardware costs, physical discomfort, and educators' adaptation to new technologies, these problems are expected to be solved as technology continues to improve. This paper mainly conducts research through literature review and case analysis, and has not yet combined empirical data or quantitative analysis methods to conduct in-depth discussions on the application effects of VR in specific educational environments. Future research can introduce methods such as questionnaires and experimental research to verify the actual impact and effectiveness of VR technology in different educational scenarios in a more empirical way. Looking to the future, the application of VR in education will still face challenges, including technological updates, innovations in teaching methods, and adaptive changes in the learning environment. At the same time, VR also brings huge opportunities, such as improving learning efficiency and stimulating students' creativity and critical thinking skills. With the development of VR technology and the reduction of costs, it is expected that VR will become an innovative and effective learning tool in the

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field of education, providing students with a richer, more interactive, and more personalized learning experience.

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