

Research and Analysis of VR in the Field of Education

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Abstract. In recent years, virtual reality has become a hot spot for applications in several fields. As a relatively new technology, every breakthrough it makes in a particular field is closely watched. The viability of this novel technology, has even begun to be applied in education. This paper mainly analyzes the teaching problems faced by some professions (medical education, science experimentation, and art education) and the application and help of virtual reality for these professions. First, this paper examines real-world uses of virtual reality in medical education, science experimentation, and art instruction. The benefits and drawbacks of these cases are presented and explored. Besides, this research also covers the professionalism of virtual reality in education, which not only boosts students' learning motivation but also improves classroom teaching quality. Finally, this article examines VR's future uses in a variety of sectors, as well as summarizing and addressing some of the most crucial issues of its usage in education.

Keywords: Virtual Reality; Immersive; Education.

1. Introduction

As a recent innovation, virtual reality (VR) may immerse viewers in a world that is wholly apart from reality through audio and visual stimulation. With the advancement of technology, VR is being utilized for more than just experiences and games. People are testing the limits of what VR is capable of, anticipating future applications for this technology. Education has always been a vital component of life, and VR technology may offer more practical and fascinating teaching while also growing in popularity in the field. Its unique interaction and immersion education field to a new level boosts students' learning efficiency while also allowing the area to be full of diversification.

The future of VR technology in the field of education is incalculable. It is one of the most topical new technologies in recent years. The latest trend in this field is using technology to create new teaching methods and environments. Because of its acoustic and visual characteristics, VR technology creates an exclusive, three-dimensional, and immersive learning environment for learners. One of the most significant advantages of VR is creating a targeted learning environment according to different professional fields, which can improve students' interest in learning and overall learning efficiency. Therefore, VR is the first new technology to be considered for application in the field of education. In medical education, VR plays an important role in ophthalmic education since it allows students to observe different experimental environments and cases vividly. Moreover, it also functions in surgery education as students can monitor virtual surgery scenarios and facilitate them to acquire knowledge through practical experiences. The rise of VR is correspondent with the emergence of traditional science education modes: the latter lacks continuous attractiveness to students, its devices require high maintenance costs, and it may lead to accidents. In art education, VR demonstrates rising potential and popularity as traditional art education modes cannot satisfy today's students. In particular, advertising and packaging design are the two majors that need VR the most because VR supports students to design and create more freely.

2. Research and Application of VR in Medical Treatment Education

2.1 Application of VR in Medical Education

In the current medical education system, students acquire more knowledge through textbooks than through clinical experience. Although there are some clinical courses, they are prone to some

limitations in practice because of the object of medical treatment in patients. Foundational knowledge lectures and clinical instruction are two of the teaching strategies used in medical education. Due to the tenuous link between the foundational knowledge lectures and the clinical setting, students may become easily bored and lose interest in learning new information. In particular, freshmen may choose to quit medical major because of the lack of attractiveness. The example of Forggipedia can explain VR's charm in the eyes of students. For freshmen, dissecting a frog may be disgusting but important to understand medical principles. The application, Froggipedia allows students to explore a frog's internal organs via VR technology [1]. Because they receive basic knowledge over such a long period, students will likely forget some information during the clinical teaching phase, making it challenging to connect the two [2]. Students can apply theoretical knowledge to clinical practice by using virtual reality technology to simulate real-world clinical scenes, which can significantly aid the innovation and advancement of medical teaching (Figure 1).

Textbooks are valuable but lack of immersive and reflection learning experience. Virtual reality could provide an actual clinic environment where the patients will be wait for those medical treatment learners. The benefits of VR technology over instructional videos are as follows:

- It can simulate clinical scenarios realistically and provide timely feedback.
- Participants can closely observe and interact with the instructional material at the same time.
- Students can begin the course anytime because VR applications are convenient.
- There is no waste since the course can be reused.



Fig 1. Shows how the light is held and moved as it would be in real life [3].

2.2 Application of VR in Surgery Training Education

Virtual reality can be used in the teaching of foundational medical knowledge. The content of foundation lectures is relatively abstract and boring. So, using virtual reality can make flat knowledge three-dimensional and physical. At the same time, it can give the function of real-time regulation, transforming boring knowledge points into impressive images and interactive processes, enhancing the students' curiosity.

When studying anatomy, students frequently dissect cadavers preserved in formalin for a long time. The drawbacks include the following: it is impossible to provide for each student's educational needs due to the overpowering smell and the cadavers' meager resources. In 1994, University of Colorado researchers processed, gathered, and published detailed anatomical datasets of two virtual humans, a male, and a female, based on physical specimens. By creating virtual anatomical scenarios and wisely using these datasets, virtual reality technology can be used to develop virtual anatomy scenarios that cater to the unique learning needs of each student while also keeping students away from the unpleasant odor [4]. By using the data to modify experiments, it also somewhat lowers the risks associated with medical conditions.

To decrease the likelihood of surgical errors occurring in the real world, Osso VR has developed a low-cost virtual operating room for surgery that allows students and surgeons to become familiar

with and learn about various surgical tools [4]. Clinical coursework must be intimately related to clinical practice, and VR technology can be leveraged to give all students a realistic, affordable, and risk-free introduction to clinical operations. For instance, CAE (Canadian Aviation Electronics, <http://www.cae.com/>) has created several clinical simulation systems, such as virtual patients with various diseases, operating tables for the nervous, cardiovascular, and digestive systems, and simulations of multiple organs using ultrasound. For instance, the CAE Healthcare CathLabVR virtual system uses active force feedback technology. It features several built-in modules that include comprehensive interventional procedures, such as contrast diagnosis, guidewire passage, balloon dilation, and stent insertion. The gradual nature of the training greatly shortens the learning time [2].

Numerous medical institutes have embraced the Destroscope virtual reality technology locally and abroad; by using operators' hands to simulate and assess various procedures on virtual images immediately, imaging data from clinical patients such as CT, MRI, DSA, and DTI can generate a virtual reality environment with three-dimensional effects and lower the risk of actual surgery. Contrarily, live stream virtual reality surgery can be carried out anywhere and is increasingly frequently utilized for exchanging and disseminating surgical knowledge. The first surgical procedure to use live stream virtual reality technology was a laparoscopic radical right hemicolectomy, streamed live at Shanghai Jiao Tong University's Ruijin Hospital in May 2016 [2].

The use of virtual reality technology in healthcare is also possible. Mannequins are used in traditional training, which is very time- and money-consuming. However, time and money are quiet reduced by using virtual reality [4].

3. Research and Application of VR in Science Experiments Education

3.1 The Downside of Traditional Education for Science Experiments

The rise of VR's application in education corresponds to the emergence of the shortcomings of traditional teaching tools. There are specific problems in the teaching of professional practice in science education.

(1) Classroom teaching lacks intuition and novelty. For contemporary students who can receive diverse information, the current language descriptions and pictures used by science education majors are not enough to arouse their enough interest. This May cause students to lose interest in learning and give up. For example, in a survey conducting among engineering students, respondents demonstrated obviously positive emotions after they tried VR teaching tools. Compared with traditional teaching tools, VR ones scored higher in terms of surprise and excitement [5].

(2) The maintenance cost of training equipment is high. Some training equipment is not only costly but also very fast to update. While adding a certain cost to the purchase of equipment, the cost of maintaining these types of equipment is also prohibitive. If the equipment is damaged and not replaced in time, it is easy to accelerate the aging of the remaining equipment, thus affecting the teaching.

(3) In the practical teaching process, there will be specific and hidden dangers. For instance, students may experience certain risks and safety hazards when conducting experiments with toxic chemicals, loud noises, or fire hazards, which could result in accidents [6].

3.2 VR in Science Experiments Education Practice

Building situational virtual labs with virtual reality technology can enrich the learning material, which will pique students' interest in learning. In addition, a lot of money and resources can be saved because the tools and medications in the virtual lab are fictional. Additionally, some items that are not real-world equivalents for a variety of reasons can be created in the virtual lab [6].

The VR virtual laboratory can help with space and time restrictions. In the virtual lab, students can test their genes by growing peas. Students can sow and water seedlings with various genes after planting them in the virtual lab by replicating the actual procedure of shoveling and covering the soil.

These seeds will develop into the corresponding pea shoots as they expand. Through VR technology, one can view and observe this process and the resulting genotypes [7].

In the case study lectures, virtual classrooms are created using virtual reality technology to help students practice simulation training and advance their analytical, problem-solving, and comprehension skills. For instance, when tasting rice, starch, and iodine, students can assess the taste of the rice by watching a virtual character evaluate it while chewing it [6]. Based on their prior knowledge, they can then determine that the rice contains starch and select the appropriate response from the display. In line with that, it makes learning much more enjoyable. Additionally, students can simulate real-world case scenarios in the virtual lab without really being in a dangerous area. For instance, in the case of the rice, starch, and iodine changing lecture, for the treatment of scenes of iodine poisoning, the virtual character lies down on the ground, and the students deduce from the text on the brown glass bottle next to the character that the character accidentally ingested iodine [8]. The exercise developed students' courage and desire to save lives while allowing them to put what they have learned into practice. Most students said the session was excellent and improved the standard of hands-on instruction in the classroom.

4. Research and Application of VR in Art Education

As technology develops, an increasing number of art majors are beginning to work in industries like games, animation, and digital media, which combine science and technology. Therefore, art education may foster students' ability to innovate if it can stay up with the times in terms of technical invention. Students in traditional art education spend much time studying software techniques but have little chance to practice the art or find their artistic style. Many students develop drafts rather than finished designs due to a lack of time or resources. With the use of virtual reality in art field, this problem can be solved.

4.1 VR in Advertising Design Major

It is possible that traditional theoretic classes are not the best way to deliver information to students majoring in advertising design. It could be challenging to turn abstract concepts into physical items because every element of the advertising plan is unique, and the final display design will be unique. The results occasionally fell short of what was anticipated in the original planning when vague language was employed to describe something. For design learners, it is essential that the design work can be used in practice. Through virtual reality, students can integrate their work into the application context. The marketing students' planning strategy may also be visualized in virtual reality. The 3D graphics rendering technology in VR allows students to illustrate their thoughts and represent abstract notions in drawings more effectively [8]. It could be challenging to turn abstract concepts into physical items, but the 3D graphics rendering technology in VR allows students to illustrate their thoughts and represent abstract notions in drawings more effectively [9]. Through virtual reality, advertising major students can integrate their works into the application context (Figure 2).



Fig 2. Illustrates how using VR technology may give students a genuine immersion in their design creations

4.2 VR in Packaging Design Major

There are a few drawbacks to packaging design education as it is currently practiced: For a brief period, students are required to design a set of assignments independently, but due to the extensive amount of material covered, the packaging structure is complex, the packing material and size are relatively complex, and additional experience is required, so the design concept and characteristic are not very good. These factors also make it simple for students to feel overly complicated and troubled, making it difficult for them to adhere.

For instance, finding a size deviation in the design phase can be challenging before the sample is released in the plan, which will necessitate redesign. It might not be the best learning method for students who are not majoring in the arts since they lack a specific basis. Also, the material itself is wasted in this situation, and it can also be frustrating for designers. Last, it is easy to start an artwork, but difficult to finish it because of the inadequate classroom instruction [10].

Students can design their packages in virtual systems with VR immersive teaching to produce a more engaging and natural teaching technique. For instance, using the virtual teaching system, students can promptly edit and adjust the size of their two-dimensional plan design before "stitching" the final output together. Until the design specifications are met, any size errors can be restored in the design drawing. The procedure is simple to follow and does not waste any design resources. The transition from two to three dimensions is tangible for students, which can enhance both learning and design effectiveness. By going through each design dimension, the students could gain knowledge of patternmaking, the addition of bias strips and interfacing to make efficient use of fabric, building blocks to construct a garment, and visualize it in three dimensions using flat pattern drawings [11]. This immersive virtual reality learning method can also be used as a platform for learning opportunities in many disciplines, including manufacturing, industrial design, and fashion design. Moreover, VR can support students to closely observe famous artworks freely. For example, the VR Museum of Fine Art on Steam allows users to closely watch worldly paintings and sculptures, including Mona Lisa, without going to a real-life museum or fighting with protective glass [3]. On such occasions, students can acquire inspirations from famous works, thus improving their professions.

5. Conclusion

This paper outlines the application of VR in the field of education and analyzes its advantages and disadvantages in medicine, scientific experiments and art. Through virtual reality technology, planar knowledge may be made three-dimensional and haptic in the field of medical education. It has the ability to transform dull knowledge into fascinating pictures and activities that may retain a child's attention. Students and doctors may become acclimated to and aware of a range of surgical equipment in a virtual operating room. Furthermore, it tackles the issue of not all pupils having access to experimental supplies. Streaming virtual reality surgery is a useful and portable method for communicating and spreading medical knowledge. Students may obtain a realistic, low-cost, and risk-free exposure to healthcare operations by employing virtual reality technology. In the field of scientific experiments, virtual reality can help with the limits of space and time. It also allows the audience to see the experiment process, the establishment of virtual laboratory can enhance the course material, improve students' interest in learning. Because the equipment of virtual laboratory is self-developed, it can save a lot of money and resources. Students can replicate real-world cases without risk. In terms of art, students can integrate their art curriculum into the VR application environment by using virtual reality. Students can express abstract ideas in paintings more successfully thanks to the 3D graphics rendering technology used in virtual reality. Students can design their own courses using VR immersive learning to achieve a more interactive and natural teaching approach. Manufacturing, industrial design, and fashion design are just a few of the many fields that could benefit from this immersive approach to virtual reality learning. Students can research each design criterion.

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