

An overall solution of Virtual Reality Classroom

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Abstract—Virtual Reality (VR) is a three-dimensional computer-generated virtual world. It is essential to introduced VR technology to education area to develop new teaching mode to improve the efficiency and quality of teaching and learning. Among them, VR classroom has quickly become most dazzling star with its subversive advantage. This paper proposes an overall integration solution of VR classroom, including its composition, its scene design of various disciplines and its main advantage. Finally, a case study of a geography lesson is provided to show its advantages and strong potentiality.

Keywords- Virtual Reality; Education; virtual classroom

I. INTRODUCTION

Virtual Reality (VR) refers to a kind of three-dimensional (3D) reality utilizing a series of sensors sensing auxiliary facilities such as anaglyph spectacles and sensing gloves, by which a variety of actions information can be transformed into the computer to get 3D visual, auditory, tactile and other sense perception [1]. It is increasingly being recognized as a useful tool for the study, assessment, and rehabilitation of cognitive processes and functional abilities. In recent years, with the rapid development of information and communication technology (ICT), VR technology has increasingly shown broad application prospect in such fields as aerospace, military simulation, medical practice, architectural design, art and education, sports training, entertainment, gaming and industrial manufacturing management [2-6]. Since VR technology can engender an immersive real feeling and can make people interact multi-dimensional information with the virtual environment, so it can have emotional and rational knowledge of the objective world from a comprehensive integration of qualitative and quantitative virtual environment, thereby deepening some certain concepts to construct new ideas and innovative features [1].

In the rapid development of ICT, the existing educational content, teaching methods and learning methods are having a great challenge [2]. With VR technologies' maturation and improvement, who has three basic features namely immersion, interactivity, and conception, it can create an environment similar to the real world, and then solve situational and natural interactive of learning media, to significantly help students

deepen feelings, inspire cognitive, and interactively innovate. So it has a very broad application prospects in the field of education [5-11]. The data shows that people can only remember 20% of what they heard, and can remember 30% of what they saw, while can remember 90% of their personal experience or simulation. VR technology can vividly show the teaching content, effectively create a fully immersive teaching environment, to improve the efficiency of students to master knowledge and skills, to optimize the teaching process, to improve the teaching quality, to mobilize students' enthusiasm, then to really make the teachers more easily to express their ideas and teaching content so that students can be more intuitive and easier to understand their teaching ideas and content to meet the needs of the knowledge presented upgrade mode, practical teaching demand, inquiry learning adaptive innovation, and the demand of STEAM (science, technology, engineering, art, mathematics) standards of quality education. Therefore, the deeply integration of VR technology and education is the future development trend of education information.

This paper proposes an overall integration solution of VR classroom, which can combine deeply the VR technology and teaching courses, to achieve compatibility convergence with the original interactive whiteboard classroom, computer classroom, and intelligent classroom, and other kinds of information teaching modes.



Figure 1. A display of VR technology

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II. THE OVERALL INTEGRATION SOLUTION OF VR CLASSROOM

A. The Constitution of VR Classroom

VR classroom solution integrates immersive VR technology and teaching and learning process, taking high-quality teaching resources as the core, integrating terminals, application system, platforms, and teaching content, to create realistic learning environment for students. It combines virtual animation and virtual space to externalize abstract concepts, to create highly open, interactive, immersive 3D learning environment. The overall integration solution of VR classroom consists of hardware terminals, educational software, and educational resources. Based on educational resources, teachers can control students' VR devices to learn educational resources via PC terminal and VR educational software.

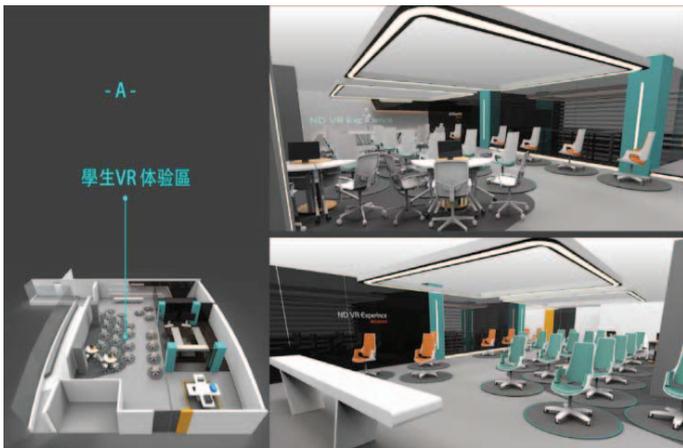


Figure 2. The Design effect diagram of VR Classroom



Figure 3. VR Classroom

B. The Classroom Scene Design of Various Disciplines

1) *Mathematic*: VR classroom can fully mobilize students' visual, auditory and other sensory participation to visualize complex abstract mathematics concepts, specifically for

spatial geometry conversion, calculus transformation, mapping tab, 3D coordinate space, percentage calculation and geometric objects.

2) *Biology*: VR classroom can create rendered mysterious microscopic world by leading VR technology, so that students can observe the life change and multiply of the cells, viruses, organs, and other life material, to understand the biological environment, biological evolution and other macro issues.

3) *Physics*: VR technique can display energy, motion and force, physical, thermal, optical, atomic, mechanical, electrical and other abstract physical problems on VR classroom, and provides a true visual learning platform to help students understand and master all kinds of practical physics laws, by available virtual experiments and exploratory operation.

4) *Chemistry*: Through panoramic VR classroom, chemistry experiment process can be achieved in the absence of relevant equipment and reagents, the virtual system can be repeatedly disregarding the loss of experimental equipment and experimental safety, to provide more figurative material for teachers, greatly expanding the students' interest and initiative.

5) *Astronomy*: "Today we're going to Mars," one astronomy teacher would say in the future. We have gained a great number local images and knowledge of such celestial bodies as Mars and Saturn, so now we can manufacture the red planet where students can be walking on and look around it.

6) *Engineering Education*: manufacturing and 3D printing are very expensive. In VR classroom, students can understand their design without spending the cost of producing their products.

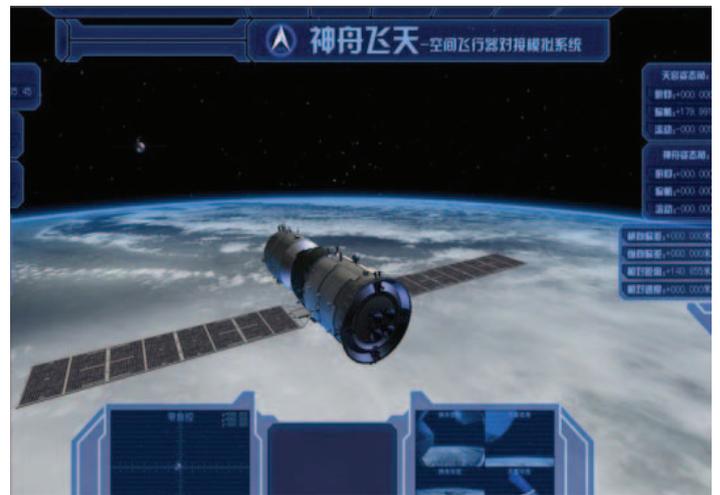


Figure 4. Virtual Space Flight Scene



Figure 5. Virtual Astronomy scene



Figure 6. Virtual Fire Escape

C. The Advantage of VR Classroom

VR classroom can provide students with an educational experience by fully immersive, secure and economical scenes, so that students can feel personally in a virtual environment.

1) Open immersion to stimulate students' interest

VR classroom has unparalleled advantages to help students understand teaching contents and improve the learning experience. Based on VR classroom, students' sense of hearing and vision are secluded outside, then they can throw themselves into virtual reality to go for an immersive feel. Students can take advantage of special VR equipment to obtain the same visual, auditory and tactile real-world-like feeling. It can cross the restrictions of time and space, and abstract concrete concepts, to experience highly open, interactive, and immersive 3D learning environment. Teachers can improve teaching purpose using interaction somatosensory and deep immersion program on VR classroom to create the desired mood and deepen knowledge and memory.

2) Safe and reliable modeling scenario

VR technology can be used in classroom teaching, mainly in physics, chemistry, geography, safety education, and so on, some of which often requires a certain dangerous or expensive experiments to be achieved. VR classroom can construct safe and reliable modeling scenario to get very nice teaching effectiveness. Students can do safely all kinds of dangerous or harmful experiments in VR classroom, for example: virtual chemistry experiments can avoid combustion or explosion produced by chemical reaction; virtual safety lessons can make students simulate how to operate or escape in such accidents as earthquake, fire, stampede and other emergency situations. In addition, interactive VR teaching can make students be very easy to make error correction, and the teacher or education managers will not also need to worry about the cost of consumption of any substance or the rehabilitation related work. VR classroom has incomparable cost advantage comparing with multimedia classroom or traditional laboratory.



Figure 7. Virtual Escape Practice in mines

III. A CASE STUDY OF EDUCATION APPLICATIONS

This section provides a set of common VR classroom teaching process, to show its unique charm. It makes all students learn efficiently understanding knowledge.

VR classroom can be fully compatible with the existing traditional school classroom, multimedia classrooms, and intelligent classroom. They are "complementary" relationship rather than "instead of" relationship. VR classrooms can be implemented and deployed simply to provide more advanced, suitable and diversified presentation in different disciplines, different types of knowledge for teachers.

Taking a geography lesson as example, the teacher hopes to enable students to understand the composition of the solar system and the universe. The previous teaching mode is that the teacher explains geography knowledge written in the textbooks or by means of videos. But, on VR classroom, using immersive VR resource allows students to enter the virtual universe environment, to freely view the composition and running of the solar system, to imitate walking in space, finally to have a more intuitive feel and get the best efficiency of knowledge acquisition. Such a vivid geography lesson includes the following steps:

1) Pre-class preparation

- a) To construct the classroom LAN with the AP equipment before the first use of VR classroom.
- b) To install education PPT on the teacher's PC, or install smart phones in the student's VR glasses box, and make sure that every smartphone has enough power standby.
- c) Teachers login education PPT, and download the required VR resources.
- d) The teacher sends VR resources to VR glasses of all students through education PPT. After all the transmission is successful, the teacher can send "play" command to play VR resources.

2) *Teaching process*

- a) Teachers can send VR resources to students' VR devices by LAN.
- b) The teacher can allow students to bring the VR glasses, so that students can begin to experience the dazzling brilliance of the sun and its planets and the boundless vastness of the running universe. In the experience process, the teacher may choose to pause at any time via computer terminal, restart and shutdown playing VR resources, to explain the knowledge points as interludes. During non-experiment teaching, the students cannot turn on the VR devices.

3) *After-class maintenance*

- a) After VR courses, teachers and students should close all the applications on their devices.
- b) The VR glasses should be placed in moisture-proof cabinets in the classroom, and the smart phones should be placed into charging cabinet slot for charging by the student or technician.

Through the above steps, a VR solar system and the universe cognitive lesson experience can be easily completed.



Figure 8. VR resource of virtual solar system

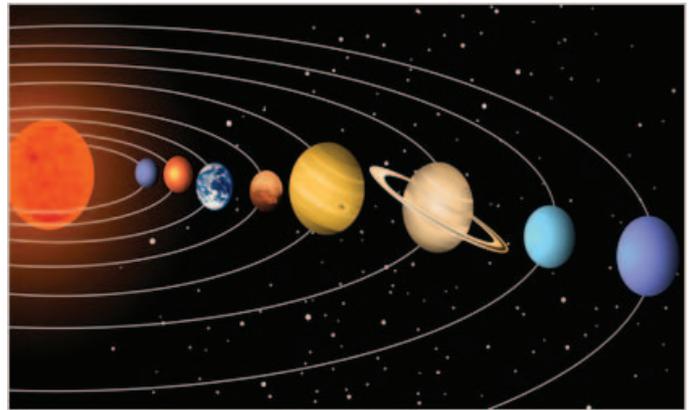


Figure 9. Virtual solar system



Figure 10. Virtual Saturn and its satellites

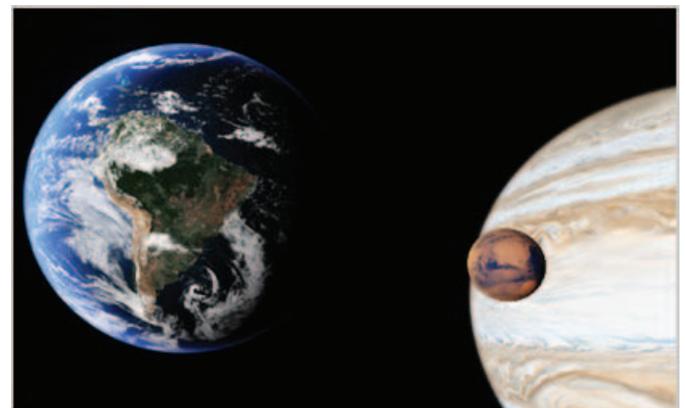


Figure 11. Virtual perspective of astronauts at space station

IV. CONCLUSION

VR has attracted more attentions for industry and education. Its prospects is very attractive, and it will change the way people think in a sense, and even change the understanding of time and space. VR can develop new teaching and learning mode. This paper proposes the overall integration solution of VR classroom, including its composition, its scene design of various disciplines and its main advantage. Finally, a case study of a geography lesson is provided. As a new teaching media, VR has its own advantages and strong potentiality, and

will be gradually attract educated workers' attention and favor, eventually be widely used and play an important role in the field of education.

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