Development and Applied Research of Scientific Education Based on AR Technology

Ling HE, Qian SHEN and Zhi-jian YIN
Jiangxi Science & Technology Normal University, Nanchang, China

Keywords: Augmented reality technology, Scientific education, Augmented reality education application.

Abstract. This paper studies the application status of AR technology and the research status of scientific education, summarizes the problems of scientific education, discusses the application of AR technology to scientific education, studies the status and cases of scientific education based on AR technology. Science education needs to be integrated with emerging information technologies and that formal education (school education) and informal education should be combined in the field of education.

Introduction

With the quick development of science and technology, in recent years, education informatization has shown a rapid development trend, and education informatization is also an inevitable trend of development. Chinese Ministry of Education has issued the "Teacher Education Revitalization Action Plan (2018-2022)", and plans to propose an "Internet + Teacher Education" innovation initiative. The main content is to make full use of new technologies such as virtual reality and artificial intelligence to promote the education of teachers. The construction and application of the teaching service platform promotes the transformation of teaching methods with the main characteristics of autonomy, cooperation and inquiry. [1] With the emergence of the concept of "revitalizing the country through science and education", "science and technology are the primary productive forces", and "science and technology are the foundation of the country's prosperity", China has clearly defined the importance of science and technology in China's strong road, so we must strengthen the emphasis on science education and the need to recognize science education. In the following, we study the problems faced by science education and explore the research of Augmented Reality technology in science education. The emergence of Augmented Reality technology has brought new opportunities and challenges to the development of scientific education. The research proposes a new direction for the development of scientific education and contributes to the integration and development of scientific education and AR technology.

Research Status of Augmented Reality Technology Application

Augmented Reality is a kind of technology that integrates virtual information into the real world and enriches the real world by simulating and overlapping it with computer technology. The commonly used implementation methods of AR are as follows: (1) specific image recognition; (2) geographic information localization; (3) human motion recognition; (4) facial recognition; (5) reality as background. For example, "Little Bear Neo" is an AR game based on specific image recognition. "Safety Education AR" is also used in the matching books to achieve AR effects with specific picture recognition. "We Love Science" is developed for the magazine named "China Love Science" and published by China Children's Press and Publications.

Virtual Environment Application of AR Technology

Key technologies for Augmented Reality technology implementation are: (1) 3D space registration technology; (2) calibration technology; (3) display technology. Display technology is the basic technology of AR technology. The display for AR has helmet-type, hand-held, projection display
and so on. IKEA uses 3D modeling technology and display technology to realize augmented reality virtual furniture. Oxford University's startup VA-ST has developed a hand-held augmented reality device called SmartSpace based on real-world technology. The Education and Training Evaluation Center of Guangdong Power Grid Co., Ltd. uses Augmented Reality technology to carry out innovative simulation training mode. [2] The complex operational training can be practiced and trained in the virtual environment. Some scholars study to design and develop the learning aid software or educational games based on Augmented Reality technology, and apply them to teaching or training, which can save costs and form a sustainable and recycling employment, and the training of virtualization can also enhance the safety factor.

Educational Application of AR Technology

Jianzhong Hu developed a learning aid software with image recognition based on Unity 3D engine and EasyAR software. This software is mainly for the students to understand the structure and process of the single screw pump. It supports learners to understand the equipment structure, learn the disassembly process and watch the dynamic running effects.[3] Scholar Fei Cheng conducted an experimental comparative analysis in order to explore the mobile learning model and its effects of augmented reality. The experimental results show that the mobile learning mode teaching with Augmented Reality can make students understand knowledge faster, more firm and more flexible.[4] It can be seen that the necessity and advantages of Augmented Reality educational application. The application potential of augmented reality technology in education is mainly reflected in [5]: (1) visualizing abstract learning content; (2) supporting contextual learning in a ubiquitous environment; (3) enhancing learners’ sense of intuition and concentration; (4) using natural methods to interact with learning objects; (5) traditional learning combined with new learning. The educational applications of augmented reality technology cover classroom learning (discipline classification) and extracurricular informal learning.

Entertainment Applications of AR Technology

With the development of mobile software and mobile devices getting better and better, the AR penetration rate achieved by the camera principle is getting higher and higher. "Dili Love Science" is an Augmented Reality educational game. The content covers astronomy, nature, geography, physics, mathematics, art, biology and many other fields. The content is rich and varied, showing the wonderful science, the starry sky, the cool battleship, the Jurassic Park, the exotic flowers, Animal world and other content. Combining Augmented Reality technology of today's technology front, the real world and the virtual world are “seamlessly integrated” to create a three-dimensional space, presenting vivid 3D models and interactive experiences in front of children, which is conducive to developing children's intelligence and expanding imagination. Inspire most of the sensory cognitive functions, so that children can achieve the purpose of playing technology and learning. AR technology can develop AR games. It can use the immersive, competitive, antagonistic and other elements of the game to integrate AR technology, virtualize the game scene into "real", more immersive and scientific. Pokemon Go is a game that captures, battles and exchanges Pokémon in the real world. Players discover elves in the real world, capturing and fighting elves. "IButterfly" is a 2010 Japanese Augmented Reality application. In the designated area, you can see the butterfly and capture it, and the captured butterfly can redeem the coupon. In addition to developing AR games, at present, people like to use Augmented Reality technology to highlight the future of technology in concerts and large evening parties.

Development and Research Status of Scientific Education

The Chinese Academy of Sciences has clearly defined the concept of scientific education in the 2001 Science Development Report. Scientific education is a kind of education that pays attention to the scientific literacy that modern people must possess in the era of science and technology. It is the
scientific knowledge, scientific thought, and scientific method. The scientific spirit as a whole system, internalizes it into the educational process of the conviction and behavior of the educated, so that the scientific attitude is closely related to the daily life of every citizen, and the scientific spirit and humanistic spirit are blended in modern civilization. [6] From the concept, it is not difficult to find that the final purpose of scientific education is to cultivate students' scientific attitudes and improve their scientific literacy. It can be seen that the concept of scientific education in China has changed from cultivating a small number of scientific and technological elites to cultivating and improving the scientific quality of citizens.

Developed countries such as the United States and the United Kingdom have invested a large amount of human and financial resources in scientific education since the last century and have vigorously developed science education. In 2013, the American Association for the Advancement of Science (AAAS) released the Next Generation Science Education Standard, which provides a blueprint for the next scientific education. As early as 1988, the United Kingdom listed science as one of the three core courses. In 2014, the Royal Society published the “Vision for Science and Mathematics Education” report, which proposed the most important position in science and mathematics as far as education is concerned. In recent years, STEAM (Science, Technology, Engineering, Art, Mathematics) education has become the mainstream of education research in developed countries such as the United Kingdom and the United States.[7] The aim of STEAM is to encourage students to development and improve comprehensively in the field of Science, Engineering, Art and Mathematics. The three most important evaluation projects in the world are PISA, TIMSS, and NARST, all of which include scientific literacy and scientific education. All of them are internationally important scientific evaluation projects, and scientific literacy and scientific education are included in the test standards.

Overall, the development of scientific education in China is in its infancy. The STS (Science, Technology, Society) movement in the 1990s, shows the impact of modern science and technology education on the natural teaching of primary schools. In 2011, the Ministry of Education introduced the “Science Curriculum Standards” (revised draft) for primary schools. After that, the primary schools began to pay attention to the science curriculum for primary students, matched the professional science teachers and specialized science courses. However, at that time, the teachers of science and technology education in primary and secondary schools in our country were still very scarce. In some places, the science curriculum was in the form of insufficient input and the level of scientific education was very different. Until 2017, the Ministry of Education issued the Compulsory Primary School Science Curriculum Standards to further strengthen primary school scientific education. It is required that since the fall of 2017, a science course will be added as a basic course in the first grade.

Scholars Lanqing Wu and Wei Ma [8] reflect on the development of scientific education in China based on the field of scientific literacy. From the concept of scientific education, they propose to promote the basic scientific literacy of all students' sustainable development. From the practical level, students are required to explore scientific attitudes in activities. The spirit of methods and sciences, from the aspects of system and management, requires the improvement of teacher training methods, education and teaching level and teaching ability. Therefore, teachers should learn to keep pace with the times, learn new teaching modes, teaching methods, teaching techniques, integrate information technology into the classroom, apply it to teaching and improve teaching ability and competitiveness. Accelerate the transformation of traditional teaching resources into networked teaching resources, use Augmented Reality technology to develop teaching resources, integrate teaching resources, and share teaching resources.

In summary, it is not difficult to find that China's scientific education has the following problems. (1) China's science education started late, and development cannot keep up with international demands for technology and scientific talents. (2) China pays insufficient attention to the scientific education of primary and secondary schools. The standards of other subjects in the compulsory education stage are set earlier and more vigorously than the scientific education standards. (3) The
professional level of science teachers in China is low, and many teachers are not able to use new teaching methods and information technology.

Research on the Application of Science Education Based on AR Technology

The rapid development of science and technology and the competition of national comprehensive national power require countries to vigorously develop science and technology and cultivate innovative talents. Information technology is considered to be one of the most effective ways to lead the development of scientific education and enhance the scientific literacy of citizens. Augmented Reality refers to superimposing virtual objects on real objects through 3D technology to achieve a visual blending enhancement effect, featuring a combination of virtual and real, seamless interaction, and infiltration learning.

The main themes of Augmented Reality education applications are three aspects: educational resource research, AR educational game research, and design-based learning research. [9] Augmented Reality technology combined with Unity 3D software engine and Vuforia technology can develop Augmented Reality educational games. Using Augmented Reality technology to develop and design educational games can make learners turn virtual and abstract concepts into concrete and visible content. The game design supported by Augmented Reality is based on immersion theory, driven by narrative, and uses two-dimensional code technology to create a mobile learning environment that encourages learners to constantly challenge tasks. [10] The use of new technologies to develop teaching resources requires a large amount of theoretical support. In the context of research on the status, it is necessary to develop educational resources and Augmented Reality educational games that meet the needs of society and learners. The mobile game based on AR technology presents a scanned physical model through a mobile phone screen or a computer display screen. The visualized virtual model can perform interactive functions such as rotation and zooming with fingers. Su Cai et al. [11] of Beijing Normal University, think that the augmented reality technology can make the abstract learning content specific, changeable and visual, and has great advantages for changing the abstract knowledge point teaching. At the same time, augmented reality technology supports situational teaching. They believe that augmented reality technology can help students achieve their goals in terms of emotions and values, and enhance their interest and concentration. So, Augmented Reality technology can greatly improve learners' learning enthusiasm and interest, and inspire the intrinsic motivation of learners' learning. Learners will be immersed in the virtual simulation world to learn knowledge easier.

Laine Teemu H et al. analyze the children's low interest in science because of the lack of motivation to learn and the relevance of the real world. Gamification learning and storytelling are important ways to learn intrinsic motivation. Linking abstract scientific concepts to the real world can be done by contextual learning in the real world or by Augmented Reality that connects virtual content with the real world. The article mentions the science point AR, which is a science learning game that creates a context-aware world. The results show that the platform is feasible. [12] The AR's immersive characteristics and the combination of virtual and real features are maximized, and their characteristics are used to abstract the scientific knowledge points for specific reality learning. In summary, the application of AR technology in scientific education can be concentrated in two aspects: development of teaching resources; application of educational games.

Summary

There are huge challenges and opportunities in the application of Augmented Reality in the scientific education. (1) The educational application of AR has high requirements on the teaching skills and professional quality of teachers. It requires teachers to continuously improve professional quality and learn new technologies and new teaching methods to develop the habit of lifelong learning. (2) Augmented Reality development equipment and Augmented Reality technology are
required to be taught by more professional people. The state, government and schools need to provide a good learning and teaching environment for science teachers, matching professional equipment and professional classrooms for learning and teaching. The society and the country's scientific literacy requirements for citizens are getting higher and higher, not only need to cultivate scientific and technological talents, but the most important thing is to improve the scientific literacy of citizens. However, the development momentum of scientific education cannot meet such requirements, and the contradiction between the two is both a challenge and an opportunity. From the levels of the national and government, we must pay attention to scientific education. We must make good use of the conditions created by the state and vigorously develop scientific education. Scientific education should not be limited to formal education. It can take a long-term view, broaden educational channels, and attach importance to informal education (science popularization) in scientific education. At present, the popularity of scientific knowledge is often involved in TV programs. The construction and popularization of public places such as science and technology museums and museums are all in the category of informal education. Finally, by taking advantage of the Internet, teaching resource sharing can maximize the use of education, and it is necessary to build a platform for sharing teaching resources so that scientific education can flourish.

References
[1] Ministry of Education, Teacher Education Revitalization Action Plan (2018-2022), Ministry of Education and other five departments, teacher (2018).
[2] Peng Wang, Zhichao Zhang, Junfeng Li, Innovation research on simulation training mode of virtual reality and augmented reality technology, China Electric Power Education. (2018)36-38.
[3] Jianzhong Hu, Design of Augmented Reality Learning Assistant Software Based on Image Recognition, Mechanical Engineering and Automation, 2018, pp. 38-40.
[4] Fei Cheng, Research on Mobile Learning Model and Effect Based on Augmented Reality, Journal of Hangzhou Dianzi University(Social Science Edition), 2018, pp.70-74.
[5] Su Cai, Peiwen Wang, Yang Yang and Enrui Liu, A review of the educational application of augmented reality (AR) technology, Journal of Distance Education, 2016, pp. 27-40.
[6] Chinese Academy of Sciences, 2001 Scientific Development Report, Beijing: Science Press, 2001.
[7] Huiliang Zhang, Analysis of the Science Education Policy in China, Popular Science Research, 2017.
[8] Yuqing Wu and Wei Ma, Reflections on Science Education in China Based on the Perspective of Scientific Literacy, Journal of Capital Normal University(Natural Science Edition), 2017, pp. 68-74.
[9] Guohua Wang and Liguo Zhang, Augmented Reality Education Application: Potential, Theme and Challenge, Modern Educational Technology, 2017, pp. 12-18.
[10] Wenyang Yang and Weiping Hu, Analysis of performance characteristics and influencing factors of AR mobile science games, Modern Distance Education Research, 2017, pp. 105-112.
[11] Cai Su, Peiwen Wang, Yang Yang and Enrui Liu, A Review of Educational Applications of Augmented Reality (AR) Technology, Journal of Distance Education, 2016, pp. 27-40.
[12] Laine Teemu H, Nygren Eeva and Dirin Amir, Science Spots AR: a platform for science learning games with augmented reality, Educational Technology Research & Development, 2016, pp. 507-531.