Research Article

The Influence of Virtual Reality Technology on the Cultivation of Agricultural Students

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Received 10 July 2021; Revised 29 July 2021; Accepted 5 August 2021; Published 11 August 2021

Virtual reality learning environment is a virtual learning environment created by the use of virtual reality technology, which expands the physical learning environment and provides learners with richer learning experience and learning resources. It has the characteristics of immersion, interaction, and imagination. From these three characteristics, this paper studies the virtual reality learning environment to promote the deeper learning of agricultural students, immersion teaching provides experience support for agricultural students’ deeper learning, interaction provides emotional support for agricultural students’ deeper learning, and imagination provides situational support for agricultural students’ deeper learning. Virtual reality technology is helpful to the cultivation of higher-order thinking of agricultural talents. It is expected to provide a reference for the future exploration of virtual reality technology to the cultivation of agricultural talents.

1. Introduction

China’s Ministry of Education has proposed the construction of “New Agriculture, New Medicine, New Engineering and New Liberal Arts.” The connotation of new agriculture is to set up a new agricultural specialty or transform the original agricultural specialty in the specialty setting of colleges and universities. Around the Rural Revitalization Strategy and ecological civilization construction, the aim is to promote the deep cross integration of agriculture, science and engineering, and literature and provide more powerful talent support for Rural Revitalization and development in promoting curriculum system and ecological civilization construction, practical teaching reform, and other aspects [1–3]. How to better cultivate knowledge-based, skill-based, and innovative agronomy professionals is the basic work to realize China’s agricultural modernization. In the process of cultivating agricultural students, we should make use of the deep integration of information technology and disciplines to cultivate modern innovative agricultural talents, better serve the construction of “agriculture, rural areas, and farmers,” and revitalize the beautiful countryside. In order to adapt to the construction requirements of “New Agriculture,” we should take learners as the center, reshape the new form of education and teaching, and promote the application of new generation information technology such as virtual reality, big data, and artificial intelligence in the transformation of learning environment and the construction of learning resources [4–7]. The agricultural students’ cultivation is affected by many factors, such as the imperfect practice teaching system and the small proportion of practice teaching hours, which cannot cover all of the practical ability cultivation scope of agricultural students. Practice teaching content is not substantial, because of time, space, safety, and other reasons; some important experiments cannot be repeated in learning and operation [8]. For agricultural students, experimental learning is an important way to review, consolidate, deepen, and expand theoretical knowledge and is an important link in cultivating students’ comprehensive practical ability and critical thinking and creative thinking. However, due to the lack of face teachers and insufficient experimental conditions in some colleges and universities, they cannot meet all the experimental projects of students, which greatly affects the quality of talent cultivation [9].
Virtual reality technology includes computer, electronic information, simulation technology, and other information technologies. It integrates a variety of related knowledge systems to form a digital representation of the real environment and scene. It can create virtual learning for experiential learning, exploratory learning, operational learning, observational learning, and so forth. Context and three-dimensional space are extremely valuable for enhancing learners’ experience and spatial perception. The virtual learning environment can effectively enhance or simulate the real teaching situation, awaken learners’ thirst for knowledge, and bring them a sensory experience different from that of traditional classrooms [10]. The basic realization way is to simulate the virtual environment by computer so as to give people a sense of immersion, interaction, and imagination [11, 12]. The basic characteristics of virtual reality technology and virtual reality learning environment are shown in Figure 1. Immersion means that learners are part of the environment. Interaction is that learners operate in virtual reality learning environment or interact with each other by using special equipment and human natural skills. Imagination is that virtual environment gives learners unlimited imagination space [14–16]. Virtual reality learning environment is a virtual learning environment created by VR technology, which expands the physical learning environment, transcends the limitation of time and place, can repeatedly operate and practice, and can try and make mistakes so as to provide learners with richer learning experience and learning resources. Virtual reality learning environment supports unlimited number of operations and experiments, which can effectively solve the current difficulties in experiment, practice, and other teaching links. Virtual reality learning environment has three-dimensional visual characteristics and strong fidelity. Learners interact with the environment, learners, learning content, and learning resources in a variety of ways. Learning in virtual reality learning environment is a kind of situational learning. Teachers and learners can carry out situational teaching and learning. The unique characteristics of virtual reality provide better learning experience for learners. The interaction between learners and environment, between learners, and between learners and learning resources can promote the occurrence of learners’ critical thinking [17].

Virtual reality technology has been proved to have a powerful teaching role in aviation, medical, nuclear power, and military fields. Boeing has developed VR to support aircraft wiring and maintenance as well as flight simulator. Due to the application of virtual reality technology, aviation industry has reduced man-made disasters by nearly 50%. Military Medicine recommends the use of VR to improve the driving skills of veterans recovering from traumatic brain injury. After testing with a virtual reality driving simulator, the veterans demonstrated improvements in driving skills and reduced driving anger [18]. Using virtual reality technology, we can learn the interdisciplinary communication course of second life in the virtual world [19]. In desktop virtual reality Earth motion system in astronomy education, the implementation of the system is to help primary school students use the principle of virtual reality to clarify the concept of Earth motion [20]. A study was conducted to observe the impact of the proposed system on learning. Virtual reality training can improve the effectiveness of nursing students’ knowledge. Virtual reality training can significantly improve the knowledge acquisition. The training can effectively provide the program content to the undergraduate students. It is suggested to carry out moderate immersion training [21–24].

We can use virtual reality technology to build a virtual simulation experiment teaching platform, combine it with crops, growth patterns, ecological real-life scenes, and other related content to make up for the shortcomings of real experimental teaching, optimize the experimental teaching effect of agronomy, and stimulate students’ enthusiasm [25]. The basic theories and knowledge of agronomy include crop growth and genetic law and crop production. The teaching in the general classroom is mainly by teachers, and learners passively accept knowledge. Moreover, when professional teachers teach the course of crop growth and genetic law, they mainly show it in the form of words, pictures, videos, animation, or actual observation, so that learners cannot experience the growth and production of crops personally. Moreover, due to the influence of season, practice base, and other factors, the classroom learning of agronomy specialty cannot achieve the synchronization with crop growth. However, the immersion, interaction, imagination, and perception of virtual reality technology can reproduce the process and knowledge of crop growth and genetic law, so that learners can carry out autonomous learning anytime and anywhere according to their own time [26–28]. There have been studies using virtual reality technology to build a teaching platform for the development of flowers and fruits of T. twig, the accumulation of sugar in the ripening period of sugarcane, the determination of field sugar and the prediction of yield, and the virtual simulation experiment teaching platform of high-yield konjac cultivation technology. Due to the development of flowers and fruits of twigs, the accumulation of sugar during the ripening period of sugarcane, and the high-yield cultivation of konjac, these experiments have requirements for observation time and location, and the production cycle of crops is long; some are

![Figure 1: The basic characteristics of virtual reality technology and virtual reality learning environment](image)
suitable for growing in middle and high mountains. Therefore, the use of virtual simulation experiment teaching platform can overcome the constraints of time, location, safety, and other conditions [29]. Virtual reality technology can effectively stimulate students’ learning motivation and enhance the learning experience. Virtual reality technology promotes learners’ learning motivation by presenting individual characteristics, real-time interaction, colorful media forms, and immersive interactive dialogues [30]. A large number of studies have shown that virtual reality can bring about positive emotions such as relaxation and pleasure and other multisensory experiences to learners and can stimulate internal motivation for learning [31].

In view of this, in order to better cultivate agricultural talents, it is necessary to cultivate the core literacy and point to the development of deeper learning and high-level thinking. Moreover, we should stress multimode and flexible teaching. Virtual reality learning environment is a new form of education, which has the characteristics of flexible teaching and active learning.

2. Agricultural Simulation Experiment Supported by Virtual Reality Technology

2.1. Using Virtual Reality Technology to Stimulate Agricultural Students’ Interest in Learning. With the use of virtual reality technology to build a virtual learning environment, learners are personally actively learning, which can mobilize learners’ thinking and fully stimulate learning interest and enthusiasm. The question is how to carry out classroom reform, promote the construction of new agriculture, and cultivate agronomy professionals to meet the needs of society. In the curriculum, we need to use the new generation of information technology to promote teaching and learning, with learners as the center and teachers as the assistant and guide, and pay attention to autonomous learning and experiential learning. This can fully stimulate learners’ interest and motivation to achieve the optimization of classroom teaching. The deep integration of virtual reality technology and agronomy curriculum makes the classroom and experimental teaching of agronomy immersive and personalized, which is conducive to the personalized and deeper learning of learners and the management of teachers’ teaching.

The agricultural crop production experiment course has strong seasonal, regional, comprehensive, and sustainable characteristics. The research object is complex biological organism, which requires sufficient experimental time, space, and other experimental conditions. The introduction of virtual reality in agronomy classroom has added the characteristics and elements of immersion, interaction, and imagination to the teaching process. The traditional classroom teaching has been dominated by teachers, and now it is dominated by learners and teachers. Learners can learn autonomously and meet their personalized learning needs without the limitation of learning time and space, which is helpful for learners to learn meaningfully. Through the design of virtual reality learning environment, the teacher presents the students with the relevant knowledge of crops, including the internal structure characteristics and growth and development rules, so that the students can visualize the abstract agricultural knowledge in the virtual reality learning environment.

2.2. Simulation of Environmental Factors by Virtual Reality Technology. Crop growth depends on light, temperature, water, gas, soil, fertilizer, and other ecological resources. The growth, development, and reproduction of crops are influenced by internal and external factors, such as internal genes and internal structure, and by external factors such as time, solar term, and region. In traditional classroom, the explanation of internal and external factors mainly depends on words, pictures, animation, audio and video, and so forth. When learners learn in the virtual learning environment, they can operate the experiment and observation objects in the virtual reality learning environment with the help of necessary equipment and produce the feeling and experience as if they operate in the real environment. They can intuitively and immersively observe and describe the internal structure and growth law of crops, which is conducive to their active learning. Combination of virtual reality and reality in the process of cultivating agricultural students and the organic combination of real experimental projects and virtual simulation experimental projects can not only allow students to participate in actual operations but also make up for the shortcomings that cannot be met by real experimental conditions [32].

Using virtual reality technology to build a virtual learning environment, the learning of agronomy specialty is set in a real and complex problem situation, and the original cognitive level and new knowledge of learners are reconstructed so as to promote their meaningful learning. Because some traditional experimental models have a lot of limitations, such as being limited by time and space, and some experiments and observations are potentially dangerous, difficult, or impossible to operate and observe, the construction of virtual reality learning environment using virtual reality technology can overcome these problems and promote learners’ deeper learning.

3. A Virtual Reality Learning Environment Promotes Deeper Learning of Agricultural Students

We use virtual reality technology to move the laboratory into the classroom, and learning is a real situation experience, which is in line with the constructivism learning theory. Constructivist learning theory advocates that learners should construct their own knowledge system by taking the meaningful experience acquired by themselves and the outside world as the content of knowledge [33].

The embodied cognition theory believes that cognition of the body, including the brain, and the body and its activities play a decisive role in the shaping of cognition [34]. The theory of embodied cognition believes that students’ meaningful learning is to transfer knowledge to different situations under the premise of deep understanding of
knowledge and develop their own thinking and problem-solving abilities in the form of practice or experiment [35]. It is discussed that meaningful learning can only be carried out when the learner’s cognition, body, and environment interact effectively. [36].

3.1. Immersion Provides Experience Support for Agricultural Students’ Deeper Learning. Deeper learning is the critical acceptance of knowledge on the basis of full understanding and the fusion and reconstruction with the original cognitive level. In this process, students complete learning transfer and then self-reflection, forming a lifelong learning ability [37]. Virtual reality technology promotes the deeper learning of agricultural students, as shown in Table 1. Under the traditional learning environment, learners’ understanding of knowledge and memory persistence are not high. Virtual reality technology can stimulate learners’ motivation to participate in learning, mobilize learners’ subjective initiative, and make them more focused on learning, which provides rich emotional experience for deeper learning. It can fully mobilize learners’ visual, auditory, tactile, and other channels for effective cognition to help learners develop hands-on ability. It is helpful to bridge the gap between theory and reality by simulating the experimental operation of agronomy specialty.

The interactivity of virtual reality is to achieve efficient and natural human-computer interaction through hardware and software, which is divided into individual interaction and social interaction. Individual interaction is mainly the interaction between learners and learning content, learning resources, and so on, while social interaction mainly includes the interaction between learners. Social interaction can promote the reconstruction of learners’ cognitive process and the development of social emotion. Deeper learning is a learning process that integrates cognition and social emotional representation. The interactivity of virtual reality can meet the requirements of learners’ deeper learning.

3.2. Interaction Provides Emotional Support for Agricultural Students’ Deeper Learning. Constructivist learning theory holds that, in the real situation, learners acquire new knowledge through continuous communication with the outside world, assimilate and adapt to their original cognitive structure, and realize the reorganization and transformation of cognitive structure. Deeper learning also emphasizes the transfer, consolidation, and application of knowledge in new situations. In the virtual reality learning environment, knowledge and learning are connected with situational activities. Learners need to find, analyze, and solve problems in real task situations. Constructivism emphasizes the important role of the real situation. Virtual reality technology greatly optimizes the learning environment, creates the situation to show the virtual scene space to learners, makes learners perceive the atmosphere and content in the scene, and enhances the students’ sense of presence.

We can use the virtual learning situation to show the knowledge that is difficult to understand in teaching and the experimental operation that is potentially dangerous, difficult, or difficult to realize, so that learners can learn personally. For example, in the practice process of simulating planting crops, learners participate in the planting process through multisensory collaboration, obtain the content information in the virtual reality learning environment, and then process the information to make behavioral decisions and interact with the learning environment through interactive functions. Learners learn virtual simulation experiment project, which is not in conflict with classroom learning and practical learning. On the contrary, it is a beneficial supplement to practical learning, and learners benefit a lot. In virtual reality learning environment, learners interact with learning content, learning resources, learning environment, and other learners, which provides a foundation for immersive and interactive deeper learning.

3.3. Imagination Provides Situational Support for Deeper Learning of Agricultural Students. Imagination refers to the thinking process of learners’ representation, criticism, creation, reasoning, and logical judgment in the virtual reality environment according to various information and their own behavior in the system. Virtual reality technology can simulate and even enlarge the real sensory stimulation in the real environment. Virtual reality technology can not only reproduce the real situation but also conceive the objective nonexistent or even impossible situation. It can span time and space barriers and simulate past and future, macro and micro, distant and near, and so forth. Molina C and Kurtulus A proposed training students to use targeted learning activities based on virtual reality applications and evaluated the improvement of students’ spatial perception ability through widely accepted spatial visualization tests [41]. It is found that virtual reality technology can promote the development of learners’ visual spatial ability. Visual spatial ability can promote learners’ deeper learning in virtual learning environment to a certain extent. Virtual reality technology can create a complex learning environment of agronomy experiment, medical anatomy, simulated surgery, biology, and so forth. Learners can solve real problems in the virtual space and realize deeper learning in this process.

Embodied interaction involves more senses, especially touch and body action. People believe that touch and body action can help to maintain acquired knowledge. The immediate sensorimotor feedback received by the hand can be transferred to working memory for further processing. This enables those students who can directly operate the animation to achieve better learning effect and in essence enables them to actively participate in the process of meaning construction.

4. Virtual Reality Technology Helps the Cultivation of Higher-Order Thinking of Agricultural Talents

Higher-order thinking is a kind of mental activity or higher-level cognitive ability that occurs at a higher level of cognition. It has critical attitude, creative performance,
autonomous learning, and it is also the ability to make reasonable judgments on things or phenomena. Virtual reality technology cannot exist without the specific situation, and the creation of the situation plays a decisive role in the impact of technology; and the situation factor is the internal component of technology. Technology changes with the dynamics and openness of the situation. Technology itself cannot directly produce thinking; it influences the occurrence of higher-order thinking through different ways of use and situations [42]. Technology is not independent of higher-order thinking. The use of technology and the development of thinking have an inherent and mutual influence. Technology plays an important role in the development of thinking. Technology itself cannot directly generate thinking but influences the occurrence and development of thinking through different ways of use and situational construction. [43].

4.1. Virtual Reality Technology Helps to Cultivate Critical Thinking of Agricultural Talents. Cultivating learners’ critical thinking is the key to cultivating high-quality talents. In virtual reality learning environment, the interactions between teachers and learners, between learners, between learners and learning content, and between learners and teaching resources are an important means to promote learners to obtain high-level critical thinking. Instructional design in virtual reality learning environment is also a key factor to promote the development of critical thinking, for example, basic concept acquisition, process from simple to complex concept, and application practice. In the virtual learning environment, the interaction between learners and learning content will affect the development of learners’ critical thinking.

The influencing factors of critical thinking development are mainly divided into internal factors and external factors. The internal factors include cognition, self-efficacy, personality, and motivation. External learning factors include learning environment factors, such as problems, situations, teaching strategies, learning tools, and learning methods. In the virtual reality learning environment, learners can interact with the objects in the virtual environment and unconsciously take the initiative to think in the process of operation so as to stimulate learners’ subjective initiative and promote the formation of their awareness of discovering, analyzing, and solving problems. In virtual reality learning environment, integrating the growth characteristics of different crops can give learners more intuitive visual experience, stimulate learners’ learning motivation, and learn the growth characteristics of different crops more deeply. In the virtual reality learning environment, learners are encouraged to plant crops, and teachers encourage learners to reflect seriously, which is conducive to the development of their critical thinking ability.

4.2. The Virtual Reality Technology Helps to Cultivate the Creativity of Agricultural Talent. The support of three-dimensional space in virtual reality learning environment brings about a sense of immersion, interaction, imagination, and rich digital virtual tools, which help learners to express their creativity. In virtual reality learning environment, the design of laboratory scene and the spatial relationship between design elements will have an impact on learners’ creative thinking. The use of virtual reality technology can vividly display the teaching content and teaching resources, stimulate learners’ learning motivation, and improve learners’ knowledge and skills. With the help of virtual reality technology, students can understand teachers’ teaching ideas and contents more intuitively and easily. In the virtual reality learning environment, the internal structure and characteristics of crops, the growth law of crops, and other teaching contents are intuitively and accurately displayed. Learners are more likely to enter the flow state in the virtual reality learning environment, making learners immersed in the learning state, constantly thinking about how to solve problems, and improving the ability to solve practical problems. Learners’ creativity is influenced by individual knowledge, cognition, learning motivation, and environment. As an external factor in the virtual reality learning environment, technology is also considered as one of the decisive factors supporting the creative process. Further analysis found that the subjects with high level of creativity were in a state of high concentration and relaxation [44].

| Virtual reality | Immersion means that learners, as a part of the virtual reality learning environment, can truly feel the reality of being a participant in the virtual reality learning environment [38]. | It provides experience support for agricultural students’ deeper learning [39] |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------|
| Interaction     | Interactivity refers to the realization of efficient and natural human-computer interaction through hardware and software and the interaction between learners and learning environment, learning resources, learning content, etc. | It provides emotional support for agricultural students’ deeper learning |
| Imagination     | Imagination means that, in the virtual reality environment, learners can carry out the thinking processes of representativeness, criticism, creation, reasoning, and logical judgment according to a variety of information and their own behavior in the system so as to obtain more knowledge and understand the deep mechanism of complex system [40]. | Imagination provides situational support for deeper learning of agricultural students’ |

Table 1: Virtual reality technology promotes the deeper learning of agricultural students.
Jiang believes that the development of higher-order thinking is the unity of psychology, teaching, and technical environment. The most effective way to develop higher-order thinking is to integrate higher-order thinking skills into specific subject teaching activities, instead of setting up special courses that cultivate higher-order thinking separately. Therefore, in order to develop higher-order thinking of agricultural students, it is necessary to use virtual reality technology to create learning situations based on the students’ original cognitive level and to carry out problem-solving and case-based learning [45]. Virtual reality technology can improve the effect of experimental teaching and is conducive to the cultivation of agricultural students’ practical exploration ability, critical thinking, and innovative thinking [46].

5. Conclusions

In this paper, we mainly discussed the influence of virtual reality technology on the cultivation of agricultural students. Learners’ learning in virtual reality learning environment will produce further immersion learning experience and autonomous learning experience. In the virtual reality learning environment, we can get the experience, which is difficult to realize in reality, such as observing the organizational structure of crops inside.

Firstly, from the perspective of using virtual reality technology to stimulate agricultural students’ interest in learning, using virtual reality technology to simulate environmental factors, this paper discussed the agricultural simulation experiment supported by virtual reality technology to promote the cultivation of agricultural talents. Virtual reality technology is used to build a virtual learning environment, so that learners can learn actively in person, so as to mobilize learners’ thinking and fully stimulate their interest and enthusiasm in learning. Secondly, in order to promote the deeper learning of agricultural students from the virtual reality learning environment, the main performance is that immersion teaching provides experience support for agricultural students’ deeper learning, interaction provides emotional support for agricultural students’ deeper learning, and imagination provides situational support for agricultural students’ deeper learning. Thirdly, virtual reality technology is conducive to the cultivation of high-level thinking of agricultural talents. Higher-order thinking is a kind of psychological activity or higher-level cognitive ability that occurs at a higher cognitive level. It has a critical attitude, creative performance, and self-learning ability. It is the ability to make a reasonable judgment on things or phenomena. Finally, the critical thinking and creativity of virtual reality technology to cultivate agricultural talents are discussed.

In the future work, it is necessary to further explore the factors affecting the professional development of agricultural students in the virtual reality environment. This is of great significance to improve the professional development level of agricultural students and provides references and basis for exploring the professional development of agricultural students in the virtual learning environment.

Data Availability

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Conflicts of Interest

The author declares no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Acknowledgments

The author acknowledges the support from the Scientific Research Project of Jilin Higher Education Federation under Grant no. JGJX2021D672 and multimedia technology foundation and application of network course in Jilin Medical University.

References

[1] Z. Z. Liu, R. Du, and S. N. Zhang, “Research on the cultivation mode of excellent talents in new agriculture in local agricultural colleges,” Heilongjiang Animal Science and Veterinary Medicine, vol. 7, pp. 47–152, 2021.
[2] J. Yang, J. Ye, Z. H. Ma, and E. K. Shen, “Research on the cultivation mode of agricultural talents based on Internet and smart agriculture,” Research and Exploration in Laboratory, vol. 3, pp. 145–148, 2021.
[3] Z. J. Wang, C. Wang, J. Q. Huang, L. T. Yi, and J. W. Li, “Exploration and practice of practical teaching of agriculture and forestry specialty under the background of new agriculture,” Research and Exploration in Laboratory, vol. 3, pp. 203–207, 2021.
[4] R. C. Zhang, L. Zhang, and Y. Z. Song, “The integration of practice teaching and innovation and entrepreneurship education of animal medicine specialty under the background of "new agriculture" -- a case study of Henan Institute of animal husbandry and economics,” Heilongjiang Animal Science and Veterinary Medicine, vol. 6, pp. 135–138, 2021.
[5] H. X. Lu, F. L. Fang, and J. K. Zhang, “Exploration of new agricultural innovative talents cultivation mode based on experimental class,” Journal of Southwest Normal University (Natural Science Edition), vol. 12, pp. 162–165, 2020.
[6] Y. Zhang, M. H. Wang, M. Zhang, and Y. B. Liu, “Research on demand transformation and cultivation trend of agricultural talents driven by "new agricultural" construction,” Modern Education Management, vol. 11, pp. 8–13, 2020.
[7] X. Jiao, H. L. Yu, G. Yang, and Y. Zhang, “Thinking and Practice on the construction of "new agriculture" in agriculture related comprehensive universities,” China University Teaching, vol. 5, pp. 22–25, 2020.
[8] Q. F. Liu and S. J. Yang, “Building a virtual simulation laboratory to promote the cultivation of innovative agronomy talents,” Equipment Management and Maintenance, vol. 9, pp. 5–6, 2019.
[9] D. Fan, Y. J. Zhang, and F. L. He, “Strategy for the cultivation of outstanding agricultural talents in plant production—taking northeast agricultural university as an example,” China Agricultural Education, vol. 2, pp. 67–71, 2013.
[10] W. D. Chen, “Design and evaluation of immersion virtual learning environment,” Ph. D. Dissertation, Central China Normal University, Wuhan, China, 2020.
[11] L. A. Cushman, K. Stein, and C. J. Duffy, “Detecting navigational deficits in cognitive aging and Alzheimer disease using virtual reality,” Neurology, vol. 71, no. 12, pp. 888–895, 2008.

[12] Y. S. Shin, "Virtual reality simulations in web-based science education," Computer Applications in Engineering Education, vol. 10, no. 1, pp. 18–25, 2010.

[13] Y. J. Wei, "Research on the design scheme of immersive virtual reality classroom," Master Dissertation, Shanghai Normal University, Shanghai, China, 2017.

[14] G. M. Ke and M. Bordegoni, "A natural user interface for navigating in organized 3d virtual contents," in Proceedings of the Virtual, Augmented and Mixed Reality. Designing and Developing Virtual and Augmented Environments, pp. 93–104, Crete, Greece, July 2014.

[15] D. Corbetta, F. Imeri, and R. Gatti, "Rehabilitation that incorporates virtual reality is more effective than standard rehabilitation for improving walking speed, balance and mobility after stroke: a systematic review," Journal of Physical Therapy, vol. 61, no. 3, pp. 117–124, 2015.

[16] L. D. A. P. Cacau, G. U. Oliveira, L. G. Maynard et al., "The use of the virtual reality as intervention tool in the postoperative of cardiac surgery," Revista Brasileira de Cirurgia Cardiovascular, vol. 28, no. 2, pp. 281–289, 2013.

[17] M. Pittara, "Virtual reality for pain management in cancer: a comprehensive review," IEEE Access, vol. 8, Article ID 3044233, 2020.

[18] S. Nilsson, B. Finnström, E. Kokinsky, and K. Enskär, "The use of Virtual Reality for needle-related procedural pain and distress in children and adolescents in a paediatric oncology unit," European Journal of Oncology Nursing, vol. 13, no. 2, pp. 102–109, 2009.

[19] A. Abdurrahman and A. Aktop, "Analysis of attention, eye-hand coordination and reaction time of young soccer players," in Proceedings of the International Conference on Sport, Education & Psychology, Romania, September 2017.

[20] Y. Shen, X. Fu, and H. J. Zeng, "Virtual reality: a new chapter in the development of educational technology," e-Education Research, vol. 41, no. 1, pp. 5–9, 2020.

[21] G. S. Lan, "5g + Intelligent Technology: building a new ecosystem of intelligent education in the intelligent + era," The Journal of Distance Education, vol. 37, no. 3, pp. 3–16, 2019.

[22] P. Li, "Promoting the application of virtual reality technology to improve the quality of higher education and teaching," Research and Exploration in Laboratory, vol. 37, no. 1, pp. 1–4, 2018.

[23] C. X. Wang, H. Li, and J. J. Shang, "Application and development prospect of educational games based on virtual reality and augmented reality," China Educational Technology, vol. 8, pp. 99–107, 2017.

[24] M. Wei, "VR/AR technology from the perspective of vocational education application," China Educational Technology, vol. 3, pp. 10–15, 2017.

[25] W. Zhang, J. Cui, and D. Cheng, "Agricultural biology virtual simulation experiment teaching resource construction," Biology Teaching Research in Colleges and Universities (Electronic Edition), vol. 5, no. 1, pp. 51–56, 2015.

[26] N. Ding and Y. M. Wang, "Application of virtual reality in Education: advantages and challenges," Modern Educational Technology, vol. 27, no. 2, pp. 19–25, 2017.

[27] Z. S. Zhang, "Educational application of virtual reality and augmented reality and Prospect of integrating reality," Modern Educational Technology, vol. 27, no. 1, pp. 21–27, 2017.

[28] D. J. Liu, "The potential, progress and challenges of the application of virtual reality technology in education," Open Education Research, vol. 22, no. 4, pp. 25–31, 2016.

[29] Z. Z. Zhang, "The application of virtual reality Education: the pursuit of physical and mental integration of Education -- starting from the" intelligent learning and VR education application academic week "of Beijing Normal University," Distance Education in China, vol. 6, pp. 5–15, 2016.

[30] J. Wang, "Perspective of application innovation of 3D technology in education," Modern Distance Education Research, vol. 1, pp. 62–71, 2015.

[31] H. X. Li and M. Y. Li, "Construction of deeper learning model based on virtual reality environment," China Educational Technology, vol. 9, pp. 68–73, 2019.

[32] A. Kurtulus and C. Uygur, "The effects of Google Sketchup based geometry activities and projects on spatial visualization ability of student mathematics teachers," Procedia - Social and Behavioral Sciences, vol. 9, pp. 384–389, 2010.

[33] Y. L. Jiang, Research on the construction of higher order thinking development model in technology rich classroom environment, PhD Dissertation, Northeast Normal University, Changchun, China, 2017.

[34] X. Z. Yang, An Empirical Study on the influence of virtual reality and EEG feedback system on creativity performance, PhD Dissertation, East China Normal University, Shanghai, China, 2018.

[35] G. P. Liu and N. Gao, The influence mechanism of gesture interactive virtual experiment on learning experience," Modern Distance Education Research, vol. 33, no. 02, pp. 22–32, 2021.

[36] G. Yang, X. L. Zheng, and F. F. Chen, "An empirical study on the promotion of learning motivation and writing achievement based on virtual panorama-based learning," E-Education Research, vol. 41, no. 1, pp. 91–98, 2020.

[37] N. Guo, "Research on the design and application of embodied learning supported by virtual reality," Master Dissertation, East China Normal University, Shanghai, China, 2017.

[38] Y. Gao, D. J. Liu, Z. Z. Huang, and R. H. Huang, "The core elements and challenges of virtual reality technology to promote learning," China Educational Technology, vol. 37, no. 10, pp. 77–87, 2016.

[39] H. Qin and B. X. Xiao, "Physical model and simulation in virtual reality environment and its application in agricultural information technology," Science and Technology Review, vol. 36, no. 11, pp. 82–94, 2018.

[40] S. B. Yang, X. D. Jiang, and X. Y. Zhao, "Construction of a virtual simulation teaching system for rice crop models," Experimental Technology and Management, vol. 35, no. 2, pp. 112–116, 2018.

[41] J. Wang and Y. Chen, "New form of resource construction: the connotation and design framework of virtual simulation resources," China Educational Technology, vol. 12, pp. 91–96, 2016.

[42] Z. H. Song, D. Chen, X. Q. Dong, Y. F. Du, H. T. Li, and X. M. Zhang, "Construction planning and practice of virtual simulation experiment teaching center for mechanical and agricultural engineering," Experimental Technology and Management, vol. 34, no. 1, pp. 5–9, 2017.

[43] X. L. Shen, J. P. Zhang, and X. Wang, "Virtual reality emotional mechanism: body schema enhances emotional arousal," China Educational Technology, vol. 12, pp. 8–15, 2019.

[44] Z. Li, "Design and development of virtual simulation experiments under the perspective of embodied cognition,"
[45] J. H. He, X. L. Huang, G. X. Han, Y. S. Liang, and X. Q. He, “An empirical study on the influencing factors of learning motivation in VR educational games,” *E-Education Research*, vol. 40, no. 8, pp. 70–77, 2019.

[46] J. H. He, X. Xiao, Y. S. Liang, and G. X. Han, “The design of learning evaluation index system based on immersive virtual reality system,” *E-Education Research*, vol. 39, no. 3, pp. 75–81, 2018.