CSCanada
Higher Education of Social Science
Vol. 23, No.1, 2022, pp. 49-53
DOI:10.3968/12773

ISSN 1927-0232 [Print]
ISSN 1927-0240 [Online]
www.cscanada.net
www.cscanada.org

Research on Design and Application of Virtual Reality Learning Environment from Perspective of Deep Learning

SU Zhenyang[a],*; WANG Shan[b]; WANG Dezhi[c]; WANG Shasha[d]

[a]Lecturer, PhD., School of Education, Huanggang Normal University, Huanggang, Hubei, China.
[b]Graduate student, School of Education, Huanggang Normal University, Huanggang, Hubei, China.
[c]Professor, School of Foreign Studies, Huanggang Normal University, Huanggang, Hubei, China.
[d]Lecturer, School of Foreign Studies, Huanggang Normal University, Huanggang, Hubei, China.
*Corresponding author.

Supported by 2021 Humanities and Social Sciences Research Project of Hubei Provincial Education Department (21Y234); 2021 Provincial Teaching Research Project of Higher Education Institutions in Hubei Province (2021443); 2021 Teaching Research Project of Huanggang Normal University (2021CE05).

Received 15 May 2022; accepted 21 August 2022
Published online 26 September 2022

Abstract

How to design learning environments to promote deep learning? Current studies mostly focus on real classroom environment or online learning environment, and there are few related studies on virtual reality learning environment. This paper tries to focus on the design and application of virtual reality technology learning environment from the perspective of deep learning, discussing the necessity, feasibility, design strategies and application. In the author's opinion, this research can promote the development and improvement of deep learning theory and learning environment design theory, and the research results can be widely used in STEAM education, popular science education, curriculum experimental teaching, vocational skills training, informal venue learning and other education or teaching fields.

Key words: Virtual reality; Deep learning; Learning environment

Su, Z. Y., Wang, S., Wang, D. Z., & Wang, S. S. (2022). Research on Design and Application of Virtual Reality Learning Environment from Perspective of Deep Learning. *Higher Education of Social Science*, *23*(1), 49-53. Available from: URL: http://www.cscanada.net/index.php/hess/article/view/12773
DOI: http://dx.doi.org/10.3968/12773

INTRODUCTION

With the rapid development of social economy and the increasingly fierce global competition for talents, it is no longer enough for students to master the relevant subject knowledge to adapt to their future career and life. In this context, the idea of deep learning as an educational goal has been put forward and developed rapidly, which has become the direction of classroom teaching reform worldwide. However, the current research mainly focuses on the real classroom environment or online learning environment, and there are few related studies on virtual reality learning environment. Virtual Reality (VR) technology mainly refers to the use of computer technology as the core of modern high-tech means to generate realistic visual, auditory, tactile and other integrated virtual environment. With the help of special equipment, the users can interact with the objects in the virtual world in a natural way, so as to produce the feeling and experience of being in the real environment. The environment constructed by virtual reality technology can either exist in reality or be difficult or impossible to achieve in the objective world. Using virtual reality technology to construct learning environment can break the time and space limitation of learning, enhancing the learners' learning motivation and learning effect.

1. THE DILEMMA OF CURRENT CLASSROOM TEACHING

Classroom is the main position of students' learning, and classroom learning effect is related to students' future development. However, there are many problems in traditional classroom learning at present.

1.1 Students' Low Interest in Learning

Good learning results require students to actively participate in classroom learning activities. Due to the large number of students in the current large class, teachers cannot pay attention to every student, which leads to low participation in the class activities. Therefore, the students have low enthusiasm for learning, the classroom atmosphere is dull, and the learning effect is not obvious.

1.2 Teachers' Traditional Teaching Methods

The traditional teaching mainly imparts knowledge, but many concepts and principles are obscure and difficult to learn. For example, in physics class, teachers explain the concepts of acceleration, voltage, magnetic field, only with words. It's not intuitive enough for teachers lack the means to explain such abstract concepts.

1.3 Teaching Scenario's Monotonous Display

The new teaching concept requires teachers to create learning situations, but the current learning situations are created only by ordinary words, pictures and videos, and all these can not interact with the students, so the students' sense of substitution is not strong, it is difficult to stimulate the students' interest of continuous learning.

2. THE ADVANTAGES OF VIRTUAL REALITY TECHNOLOGY

At present, virtual reality technology has been widely used in the field of education, which provides a new teaching method for the majority of educators and expands the development space of teaching means.

2.1 VR Technology Can Provide a More Intuitive Way of Presenting Information

VR technology can break through the limitations of the blackboard and establish virtual scenes. More importantly, VR technology can enable students to have an intuitive understanding of the learning content and deepen their understanding. For example, when explaining relative speed, teachers can create scenes of cars running on the road at different speeds. Students can feel the change of speed through the perspective of different cars, so that they can have a profound understanding of relative speed and absolute speed.

2.2 VR Technology Can Create More Realistic Teaching Situation

The teaching environment created by VR technology can stimulate students' multiple senses and allow students to observe various details in the physical situation from multiple angles, making it easier for students to immerse themselves in the learning environment. Taking the "linear propagation of light" in physics course as an example, teachers can build virtual models of solar and lunar eclipses through VR technology, allowing students to observe from different angles, analyze the causes of solar and lunar eclipses, and understand the position relationship of the sun, the earth and the moon in solar and lunar eclipses. Through the creation of such a situation, students can get a deep memory. Students can also understand the knowledge more profoundly, specifically, and thoroughly.

2.3 VR Technology Can Stimulate Students' Learning Motivation and Enhance Students' Learning Experience

In traditional classroom learning activities, for various reasons, it is difficult for students to fully participate in the learning activities organized by teachers. In VR teaching mode, virtual reality technology can create realistic scenes and provide dynamic and highly interactive settings, in which learners show high learning motivation and engagement.

3. THE DEEP LEARNING AND LEARNING ENVIRONMENT

The William and Flora Hewlett Foundation define deep learning as follows: deep learning is the ability with which students can be competent for the 21st century work and civic life. The ability makes the students grasp and understand the discipline knowledge flexibly and use this knowledge to solve the problems in the study and future work, mainly including mastering core disciplines content, thinking critically and solving complex problems, working collaboratively, communicating effectively, learning how to learn, and developing academic mindsets (Huberman, Bitter, Anthony, & O'Day 2014). Scholars at home and abroad have conducted a large number of studies on deep learning, which mainly focus on: the deep participation in learning (Shun et al., 2008; Terrenghi, Diana, Zurloni, Rivoltella, & Anguera, 2019), the adoption of higher-order learning strategies ((Evans & Cuffe, 2010; Thomas et al., 2016), the development of higher-order knowledge and ability (Wang, Pascarella, Laird, & Ribera, 2015; Duan, 2012), and transfer and application of knowledge (Liu & Hao, 2017; Nielsen, 2016). Foreign studies tend to promote students' deep participation in learning and adopt higher-order learning strategies, while domestic studies pay more attention to the development and transfer of students' higher-order knowledge and ability. Although the theoretical research of deep learning has been in full swing, the practical research needs to be strengthened.

The occurrence of deep learning is related to students themselves, environmental conditions, teachers' guidance and other factors, among which a suitable learning environment is the basic condition of deep learning. Trigwell and Prosser (2009) believe that a good learning environment can develop students' more complex and higher-order cognitive skills, allow students to gain

deeper conceptual understanding, and improve their metacognitive skills. According to Corte (2000), the key questions to test whether the learning environment is strong include: whether teaching can guide students to learn to think, learn, cooperate and self-regulate; whether teaching can change to more experiential, active, developmental, constructive, goal-oriented and reflective learning; can teaching pay more attention to students' self-directed learning? Zhu (2016), Zhong (2005) and other scholars have also studied the construction of learning environment from the perspective of deep learning, but most of these studies belong to real classroom environment or online learning environment, and there are few studies on virtual reality learning environment.

4. THE DESIGN STRATEGIES OF VIRTUAL REALITY LEARNING ENVIRONMENT FROM THE PERSPECTIVE OF DEEP LEARNING

4.1 Constructing Real Scenes to Promote Situational Learning

Constructivism Learning Theory emphasizes the context of learning, and virtual reality technology can be used to construct virtual scenes, so as to promote the occurrence of students' learning. Virtual campus, virtual museum, virtual laboratory and virtual learning partners can be established through virtual reality technology. Students can not only roam in the scene, but also interact with the environment to complete virtual experiments. They can also study together with virtual learning partners to increase their interest in learning. According to situated learning theory, deep learning can only occur when it is embedded in the social and physical context within which it will be used (Brown, Collins, & Duguid, 1988).

In order to increase the authenticity of the physical scene of the learning environment, the physical modeling not only requires the appearance of the model realistic image, but also requires some objects to have complex physical attributes and interactive functions. In addition, learners have high requirements for real-time performance of virtual systems, which requires simplification and optimization of model data in scenes. In sound modeling, it is necessary to model according to the physical location of the learner, so that the sound can be distributed in the three-dimensional space to achieve the real feeling of listening. In order to increase the authenticity of the scene, the natural interaction technology can also be used to design the voice interaction and gesture interaction between the learner and the learning system.

To increase the authenticity of the social context of the learning environment, the following strategies can be used: setting engaging and authentic tasks (Herrington, Reeves, & Oliver, 2010); appropriate and effective use of representative media (Boyle, 1997); learner control with appropriate scaffolding support (Luckin, 2010).

4.2 Constructing Multiple Interactions to Promote Embodied Experience

Embodied cognition theory holds that human cognition is inseparable from the participation of the body. It emphasizes the importance of the body and its interaction with the environment in learning activities. Vision, hearing, touch and kinesthesia are learners' perceptual channels, which are involved in learners' perception, understanding and memory of knowledge. Therefore, multi-dimensional channels should be constructed in the virtual learning environment to make full use of pictures, text, animation, video and other ways to present information, enhancing the learning effect, which is also in line with the Cognitive Theory of Multimedia Learning (Mayer, 2014). At the same time, the virtual reality learning environment should also support learners to use their bodies to interact with the learning content. For example, head movement can be detected by sensors embedded in headphones (Alawadhi, Alhabib, Murad, Aldeei, & Al-Kork, 2017). The motion and infrared sensors can record head movements for orientation within virtual space (Harrington, Kavanagh, Quinlan, Ryan, & O"Keeffe, 2018), or track the user's position (Gerloni et al., 2018). Pressing the touch pad on the controller or clicking the map to send to the desired location (Pena & Ragan, 2017) can interact with objects, instruments or text within the virtual reality platform.

4.3 Building System Resources to Promote Timely Reflection

It is not the learning environment itself that influences learning, but students' perceptions of learning (Entwistle, 1991). Students will always explain the instructional intervention, and this explanation will trigger the influence of the learning environment Elen & Lowyck, 2000). Workload, teaching support, clarity of goals, etc., all affects students' learning methods. In virtual reality learning environment, system resources and sufficient learning support should be provided for students, so as to reduce the cognitive burden of students and encourage them to reflect. These system resources include learning objectives, phased tasks, learning cases, scaffolding, etc. With the support of these resources, students can continue to explore in the environment and carry out learning reflection.

5. THE APPLICATION OF VIRTUAL REALITY LEARNING ENVIRONMENT FROM THE PERSPECTIVE OF DEEP LEARNING

"Newton's first law" is the first section of the eighth chapter "Motion and force" of the compulsory education textbook (the second volume of the eighth grade "Physics"). This section includes three parts: Exploring

the influence of resistance on object motion, Newton's first law and inertia. The team used Unity 3D to develop a desktop virtual reality learning environment for learners to use on the computer side. Learners can control the model with the mouse, roam around the environment and interact with the environment. The teaching process is divided into three stages: "Pre-class", "While-class" and "Post-class".

5.1 Pre-class

Before the formal implementation of the teaching, the teacher distributed the prior knowledge test questionnaire to the students, and grouped the learners according to their scores. In order to avoid the situation of "free riding" in collaborative learning, the learners with similar learning situation in all aspects were divided into a group. Study guides are distributed to students. This section describes the teaching objectives, study recommendations, and instructions for using the study software.

5.2 While-class

Students mainly use virtual reality software for inquiry learning. Students wear VR devices and control the VR handle to select the observed objects independently for experimental learning. Students can carry out exploratory learning activities by means of independent inquiry or cooperative learning according to the questions they need to explore. It is worth noting that in the process of guiding students to conduct independent inquiry, teachers should not only respect the independence of students and allow them to construct their own knowledge system in the process of independent inquiry, but also ensure that they can help students achieve greater learning effects in a limited time. When guiding cooperative learning activities, teachers should not only provide students with support and help in knowledge and skills, but most importantly, comprehensively use the organizing forms of activities to mobilize students' enthusiasm and initiative to participate. At the same time, instructors should give students methodological guidance in cooperative learning activities and provide appropriate decision support services to ensure the smooth development of cooperative learning activities. The experimental inquiry learning process of "Exploring the Influence of Resistance on Exercise" is shown in Table 1.

Table 1
Learning process of "Exploring the Influence of Resistance on Exercise"

Exploration process	Specific link
Research Question	Does a body need force to keep it moving?
Experiment Hypothesis	No force is needed to keep a body moving
Hypothesis Verification	The experimental group and the control group were set to explore the motion of the car subjected to different resistance.
Implementation Process	Work in groups to complete the experiment.
Conclusion	Draw a conclusion based on the experimental results.

After the independent inquiry or cooperative learning activities, results will be displayed and communicated. In this process, students mainly show their learning achievements and share their learning experiences through limited time speeches, discussions and other forms. In this process, teachers should not only give comments and guidance to students' learning outcomes, guide students to reflect on their gains in knowledge and skills, but also guide students to reflect and summarize the learning process, learning attitude, learning experience, learning methods and other aspects.

5.3 Post-class

The post-test consists of 10 multiple choice questions and 2 short answer questions, which are provided by two physics teachers with more than 10 years of teaching experience to ensure the reliability and validity of the test. In-depth interviews were conducted with some students.

Through the experiment, it is found that compared with the traditional classroom, the learners have strong learning motivation and are more willing to participate in the classroom learning, which has achieved better learning effects.

CONCLUSION

Deep learning is a hot spot in education research in recent years, and the development of deep learning needs the support of VR technology combined with related learning resources and tools. This paper analyzes the advantages of virtual reality technology applied in classroom teaching, constructs virtual reality learning environment under the guidance of deep learning theory, and puts forward the construction strategy of deep virtual reality learning environment. Through teaching experiments, it is found that virtual reality technology can provide technical support for deep learning, and virtual reality learning environment can stimulate students' learning interest and help them achieve better learning effects.

REFERENCES

Alawadhi, S., Alhabib, N., Murad, D., Aldeei, F., & Al-Kork, S. (2017). Virtual reality application for interactive and informative learning. *2017 2nd international conference on bio-engineering for smart technologies*, 1-4.

Boyle, T. (1997). Design for multimedia learning. *Prentice Hall.*

Brown, J. S., Collins, A., & Duguid, P. (1988). Situated cognition and the culture of learning. *Educational Researcher*, *18*(1), 32-42.

Corte, E. D. (2000). Marrying theory building and the improvement of school practice: a permanent challenge for instructional psychology. *Learning & Instruction*, *10*(3), 249-266.

Duan, J. J. (2012). Research on strategies to promote deep Learning in e-learning environment. *China Educational Technology*, (5), 38-43.

Elen, J., & Lowyck, J. (2000). Instructional metacognitive knowledge: A qualitative study on conceptions of freshman about instruction. *Journal of Curriculum Studies*, *32*(3), 421-444.

Entwistle, N. J. (1991). Approaches to learning and perceptions of the learning environment. Introduction to the special issue. *Higher Education*, *22*, 201-204.

Evans, D., & Cuffe, T. (2010). Near-peer teaching in anatomy: an approach for deeper learning. *Anatomical Sciences Education*.

Gerloni, I. G., Carchiolo, V., Vitello, F. R., Sciacca, E., Becciani, U., Costa, A., et al. (2018). *Immersive virtual reality for earth sciences*. 2018 Federated Conference on Computer Science and Information System, 527-534.

Harrington, C. M., Kavanagh, D. O., Quinlan, J. F., Ryan, D., Dicker, P., & O"Keeffe, D., et al. (2017). Development and evaluation of a trauma decision-making simulator in oculus virtual reality. *The American Journal of Surgery*, *215*(1), 42-47.

Herrington, J., Reeves, T., & Oliver, R. (2010). A guide to authentic e-learning. *New York: Routledge.*

Huberman, M., Bitter, C., Anthony, J., & O'Day, J. (2014). The Shape of Deeper Learning: Strategies, Structures, and Cultures in Deeper Learning Network High Schools. *American institutes for research.*

Liu, Z. Y., & Hao, X. X. (2017). Research on evaluation model of deep learning. *Modern Educational Technology, 27*(4), 12-18.

Luckin, R. (2010). Re-designing learning contexts: Technology-rich, learner-centred ecologies. *Routledge.*

Mayer, R. (2014). The Cambridge handbook of multimedia learning. *Cambridge: Cambridge University Press.*

Nielsen, A. (2016). Concept-Based Learning in Clinical Experiences: Bringing Theory to Clinical Education for Deep Learning. *Journal of Nursing Education*, 55(7), 365-371.

Pena, A. M., & Ragan, E. D. (2017). Contextualizing construction accident reports in virtual environments for safety education. *Virtual Reality.* IEEE.

Shun, Lau, Arief, Darmanegara, Liem, & Youyan, et al. (2008). Task-and self-related pathways to deep learning: The mediating role of achievement goals, classroom attentiveness, and group participation. *British Journal of Educational Psychology*, *78*(4), 639-662.

Terrenghi, I., Diana, B., Zurloni, V., Rivoltella, P. C., & Anguera, M. T. (2019). Episode of Situated Learning to Enhance Student Engagement and Promote Deep Learning: Preliminary Results in a High School Classroom. *Frontiers in psychology*, *10*, 1-13.

Thomas, F., Nelson, S., Tricia, A., et al. (2016). Deeply affecting first-year students' thinking: Deep approaches to learning and three dimensions of cognitive development. *The Journal of Higher Education*, *85*(3), 402-432.

Trigwell, K., & Prosser, M. (2009). Improving the quality of student learning: The influence of learning context and student approaches to learning on learning outcomes the quality of student learning: The influence of learning improving to learning on learning outcomes context and student. *Higher Education*, *22*(3), 251-266.

Wang, J. S., Pascarella, E. T., Laird, T. F. N., & Ribera, A. K. (2015). How clear and organized classroom instruction and deep approaches to learning affect growth in critical thinking and need for cognition. *Studies in Higher Education*.

Zhong, Z. X. (2005). On learning environment design. *e-Education Research,* (7), 39-45.

Zhu, Z. T. (2016). New development of Smart education: From flipped classroom to smart classroom and smart learning space. *Open Education Research*, *22*(1), 18-26.